A Comparison of Two Computer-Assisted Remedial Reading Programs for Adolescent Unskilled Readers: Component Reading Skills and Repeated Reading

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ABSTRACT

This study compared the relative effectiveness of two computerized remedial reading programs in improving the reading word recognition, rate, and comprehension of adolescent readers demonstrating significant and long-standing reading difficulties. One of the programs involved was Autoskill Component Reading Subskills Program, which provides instruction in isolated letters, syllables, and words, to a point of rapid automatic responding. This program also incorporates reading disability subtypes in its approach. The second program, Read It Again, Sam, delivers a repeated reading strategy. The study also examined the feasibility of using peer tutors in association with these two programs.

Grade 9 students at a secondary vocational school who satisfied specific criteria with respect to cognitive and reading ability participated. Eighteen students were randomly assigned to three matched groups, based on prior screening on a battery of reading achievement tests. Two groups received training with one of the computer programs; the third group acted as a control and received the remedial reading program offered within the regular classroom. The groups met daily with a trained tutor for approximately 35 minutes, and were required to accumulate twenty hours of instruction. At the conclusion of the

program, the pretest battery was repeated.

No significant differences were found in the treatment effects of the two computer groups. Each of the two treatment groups was able to effect significantly improved reading word recognition and rate, relative to the control group. Comprehension gains were modest. The treatment groups demonstrated a significant gain, relative to the control group, on one of the three comprehension measures; only trends toward a gain were noted on the remaining two measures.

The tutoring partnership appeared to be a viable alternative for the teacher seeking to provide individualized computerized remedial programs for adolescent unskilled readers. Both programs took advantage of computer technology in providing individualized drill and practice, instant feedback, and ongoing record-keeping. With limited cautions, each of these programs was considered effective and practical for use with adolescent unskilled readers.

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An Introduction To The Study

There is no doubt that literacy is basic to adequate functioning in modern society. Presently, there exists considerable concern within and beyond Canadian borders that the illiteracy rate of the adult population is unacceptable. In attempting to identify possible efforts to rectify this problem, the educational system remains a central focus for solutions. Considerable discussion has taken place with respect to the potential of the school in dealing with the problem of illiteracy.

A recent Toronto seminar entitled "Literacy in Industrialized Countries", sponsored by the International Council for Adult Education, issued a declaration stating that illiteracy is a major problem in industrialized countries (Gayfer, 1987a). There is however, no strong agreement with respect to the definition or incidence of illiteracy. A recent Canadian literacy survey (Southam News, 1987) reported difficulty in arriving at a generally accepted definition. Literacy is described as more than the ability to read, write, and compute (Gayfer, 1987a). In the interests of a common understanding, the Southam Report's (1987) definitions are included: the term "illiterate" refers to adult Canadians who are unable to, or who can barely read or write; those whose reading, writing, and number skills are not adequate for functioning in everyday Canadian life, are termed "functional illiterates".

A variation in the accepted definition of literacy or illiteracy has, of course, resulted in varying estimates of the number of Canadians who are illiterate. For example, the Southam News report suggests that 8% of the adult population is basically illiterate, and 16% is functionally illiterate. The report suggests that its own more stringent criterion of functional literacy may be a factor in the determination of the functional illiteracy rate being 4% higher than that determined by Statistics Canada. Another review of national literacy campaigns indicates that as much as one fourth of the Canadian population appears to be illiterate (Arnove & Graff, 1988). An American estimate indicates that from 20 to 30 % of the American population may have difficulty coping with common reading tasks and materials (Stedman & Kaestle, 1987).

Such alarming estimates are also balanced by the warning that the determination of a functional level of literacy may be subjective, and hence unfair to the wide spectrum of the Canadian population (Fagan, 1988). Indeed, Fagan suggests that one absolute standard of literacy for all may be unrealistic. This view is substantiated by a large proportion of the subjects of this discussion. Indeed, the Southam News Report (1987) indicates that as many as 75% of illiterates do not consider their illiteracy to be limiting in their job roles. Further, standards for what is considered functional literacy may change as a function of time, according to the demands of knowledge, skills, and understanding, placed upon the individual by advancing technology (Gayfer, 1987a).

While such warnings must be heeded, it appears logical to state that as it appears to be a fundamental belief of Canadian society to encourage the individual to maximize his abilities, there will be continued efforts to raise literacy levels to those suited to the individual's abilities and role in society. The school, as society's chief educational instrument for the development of its young, can play a significant role in this task. Indeed, Stedman and Kaestle (1987), in reviewing the literacy trends in the United States since the year 1880, share the realization of the problem of illiteracy, but indicate that accusations of a decline in literacy skills are open to question. In fact, the authors indicate that the rise in school attainment witnessed during the twentieth century has led to a much more literate population.

The Southam Report (1987) bears out the significance of education. It identifies education as being the most important factor affecting literacy, including statistics that indicate a positive correlation between level of schooling and literacy. The importance of encouraging individuals to continue their education is stressed. A concern is expressed by Stedman and Kaestle (1987), that school attainment is no longer rising. In fact, they indicate that dropout rates in the United States are increasing. In his recent report to the government of Ontario, Radwanski (1987) also indicates a concern with the dropout rate; approximately 31-33% of Ontario students enrolled in grade 9 drop out before successfully completing Grade 12 and obtaining the Secondary School Graduation Diploma. A reason given most frequently for not finishing high school was lack of motivation (Southam News, 1987) and personal reasons (Radwanski, 1987). Radwanski reports that the most problematic subjects for dropouts appear to be mathematics and English, and notes that all studies examined indicate a strong correlation between learning difficulties and the likelihood of dropping out. This is supported as well by Hahn (1987), who identifies poor academic performance as one of several risk factors for dropping out. Radwanski (1987) reports that a significant number of students entering grade nine apparently do not possess reading and writing skills adequate to complete the grade nine program successfully. Warner, Schumaker, Alley, and Deshler (cited in Snider & Tarver, 1987) indicate that learning disabled students appear to plateau at a fourth or fifth grade reading level early in high school, showing little further progress. Indeed, Radwanski suggests that students dropping out of school prior to graduation are at risk of becoming the illiterate adults of the next generation. And yet only 10% of those illiterates surveyed by the Southam News indicated the intention to participate, or were currently participating in a remedial language course. Hence the responsibility and enormous potential of the school in maintaining the interest of its secondary students, and providing appropriate and motivating remedial programming, becomes more significant.

There recently has become available to the school new resources that may hold tremendous potential for this task. The last decade has witnessed a proliferous period of research developments in the area of reading, with implications for remediation that may be fruitful for students who demonstrate difficulties in these subject areas. Reading research has included perspectives on the decoding process and its role in impeding or facilitating comprehension (Laberge & Samuels, 1974; Perfetti, 1985; Stanovich, 1980). Specific remedial techniques such as repeated reading (Dowhower, 1987; Herman, 1985; O'Shea, Sindelar, & O'Shea, 1987; Rashotte & Torgesen, 1985; Samuels, 1979) and component skills training (Fiedorowicz & Trites, 1987; Lyon, 1985) have also received attention. In addition, this decade has witnessed increasing availability of computer technology to the schools. Research has probed the efficacy of computer-assisted instruction (Balajthy, 1987; Ellis & Sabornie, 1986; Semmel & Lieber, 1986;

Torgesen, 1986; Warren & Rosebery, 1988) as well as the evaluation of specific computer-assisted remedial reading programs (Carver & Hoffman, 1981; Cohen, Torgesen, & Torgesen, 1988; Fiedorowicz & Trites, 1987; Roth & Beck, 1987; Torgesen, Waters, Cohen, & Torgesen, 1988). The efficacy of peer tutors has also received support (Delquadri, Greenwood, Whorton, Carta, & Hall, 1986; Devin-Sheehan, Feldman, & Allen, 1976; Jenkins & Jenkins, 1985; Mahheady, Sacca, & Harper, 1988; Osguthorpe & Scruggs, 1986; Topping, 1989).

It is the objective of the present study to provide secondary school students demonstrating significant and long-standing difficulties in reading, with two different remedial reading programs. The focus of this study will be those students streamed into lower-level school programs, as this population as been identified as more likely to become adults that may be functionally illiterate (Gayfer, 1987b). To this end, this study will seek to compare the relative strengths of two remedial reading programs for unskilled readers at the secondary level in a vocational school setting. The programs will be delivered by means of computer technology with the assistance of peer tutors. In doing so, the study will attempt to identify research-based recommendations that may facilitate the development of literacy skills in this group of students beginning secondary school.

Definition of Terms

Automaticity - This term refers to the manner in which the reader is able to identify a word. The child who is demonstrating automaticity of response is able to retrieve a word from long-term memory both accurately and quickly. He/she is able to identify the word "automatically", with little attention required for the identification process. (Samuels, 1979).

Component Skills Training - This approach to training is based on the assumption that knowledge of the component skills of reading can be put to use in developing assessment and training materials to use with the unskilled reader. Torgesen (1979) suggests a task-analysis approach, which analyzes the reading task into its component skills, and then facilitates the development of diagnostic tests to assess the processes necessary to learn these skills. This approach assumes that reading difficulties are the result of inadequate practice, and that additional instruction focusing on the area of weakness will serve to ameliorate the difficulty. The research carried out by Doehring, Trites, Patel, and Fiedorowicz (1981) identified basic coding and word recognition skills as targets for remedial reading programs. This group's research indicated that reading disabilities interacted with lower-level, rather than higher-level language skills. The specific component skills targeted were reading isolated letters, syllables, and words. A study implemented by Fiedorowicz and Trites (1987) indicated that training of such component skills served to improve both word recognition and comprehension.

Computer-Assisted Instruction - The increased availability and affordability of microcomputer technology, along with public pressure advocating incorporation of computer technology in the school's educational programs (Ellis & Sabornie, 1986; Rude, 1986) has encouraged the increased use of computers as an instructional tool. The computer can provide a wide range of instructional support, from drill and practice to problem solving. Two types of computer-assisted instruction are emphasized in the present study. One is drill and practice, in which the computer provides the amount of reinforcement and repetition required to achieve mastery and/or automaticity of content of the curriculum, as is appropriate. Another is the provision of individualized remedial assistance according to the child's identified weaknesses.

Decoding - Decoding is the process by which the underlying phonetic representation is accessed from the visual stimulus (Roth & Beck, 1987). The term does not refer to strategies used by beginning readers for attacking words based on slow and attention-demanding applications of rules. Nor does it mean simply saying the word aloud (Perfetti, 1985). It does not apply only to words, but to any phonetically transformable string of letters (Perfetti, 1985). For skilled reading, the terms decoding and word recognition are used synonymously. In this case, letter strings smaller than the word level are automatically activated in a manner which facilitates word identification with minimal demand on attention.

Latency - This term is used frequently in the Autoskill Component Reading Subskills computer program. It refers to the speed of response. The student must fulfill specific latency and accuracy criteria on one subprogram, before being allowed to move on to a new subprogram.

Repeated Reading - Repeated reading is an instructional strategy designed to facilitate the reader's decoding fluency. It is based upon the automaticity theory, which states that accurate, effortless, and automatic decoding of the text uses a minimum of attention, and hence frees attention for comprehension processes. A number of variations of this strategy are possible. Students are required to read and reread a selection, usually of 50 - 200 words, to a criterion speed of 85 - 100 words per minutes (Dowhower, 1989), or for a specific number of readings. O'Shea, Sindelar, & O'Shea (1987) recommend a limit of three readings of a passage. The reading may be assisted (modelled by a peer, tutor, teacher, parent, or audiotape) or unassisted. Speed of reading is considered more important than accuracy; accuracy is seen to develop as the reader's speed increases.

Peer Tutoring - Peer tutoring refers to one student assisting another student to gain knowledge or skills, with the guidance and supervision of a trained teacher. This instructional strategy has attracted increased interest due to the heavy demands placed on teachers' time, the wide variety of student needs to be met within any one classroom, its demonstrated cost-effectiveness, and especially the efficacy of the approach as demonstrated by recent research, both for the tutor and tutee. Various types of tutoring situations are possible: cross-age tutoring - the tutor and tutee are not the same age; intra-class tutoring - the tutor and tutee are in the same classroom; reverse-role tutoring - a handicapped tutor may work with an unhandicapped tutor; classwide tutoring - the entire class participates in the tutoring exercise, with tutor and tutee reversing roles on a regular basis (also called reciprocal tutoring); cross-classroom tutoring - the tutor works with a tutee from a different classroom.

Unskilled Reader - For the purposes of the present study, the term unskilled reader or low-ability reader will be used, in contrast to the term reading disability. Vellutino (1980) has outlined a number of criteria that must be present in order for a child to be labelled as reading disabled. The child must be of average intelligence, demonstrate no sensory, neurological, physical, or emotional disabilities, and demonstrate reading achievement two or more years below grade placement (Beginning readers are not expected to demonstrate such a large gap). The reading difficulty must not be due to socio-economic or cultural factors. There exists in schools and in society in general however, a wide range of reading talent (Perfetti, 1985). Many readers are never labelled as reading disabled, but nevertheless demonstrate varying levels of difficulty in reading. Perfetti hypothesizes that reading ability may exist as a continuum, with reading disabled children occupying one extreme of this continuum, and skilled readers the other. This hypothesis is one that may be supported by teachers of reading, who may suggest that children in their classrooms demonstrate quantitative differences in their ability to read effectively. As such, within this study, there will be no attempt to identify the subjects as reading disabled according to pre-established criteria for reading disability. Nevertheless the unskilled readers selected for this study may indeed demonstrate cognitive ability in the average range, and demonstrate a reading deficit ongoing for a number of years. A gap between placement and reading achievement, of at least two years, may exist. Students with debilitating sensory, physical, or known neurological defects will not be included. There will be no attempt to identify socio-economic or cultural status of the subjects. The focus of the study will not be to label the students, but rather to focus on their ongoing reading difficulties and identification of possible remedial strategies.

Chapter Two

Review of the Literature

The fields of reading and reading disabilities are both complex and controversial. Some of the difficulties in understanding these fields may be due to the complexity of the processes involved, and to difficulty in unravelling these complexities through careful research (Doehring et al., 1981; Vellutino, 1980). While there remains significant disagreement with respect to the processes involved in reading, the perceived etiology and nature of the disability, and subsequent remedial techniques, progress in understanding has been demonstrated (Stanovich, 1982a), and there are a number of points on which common ground has been achieved.

Decoding and Comprehension : A Relationship

It is generally recognized that reading involves at least two components. Perfetti (1985) describes the two chief processes involved as lexical access processes, which facilitate the identification of words, and comprehension processes, in which the reader builds a representation of the text. Samuels (1981) refers to the two components as decoding and comprehension. And while there is agreement among scholars and laymen alike that the primary purpose of reading is to derive meaning from the text, there appears to be no doubt that the efficiency of the reader's lexical access processes may place significant limits on his ability to comprehend. The relationship between decoding and comprehension has been demonstrated in the work of several prominent theorists (Chall, 1979, 1989; Laberge & Samuels, 1974; Samuels, 1979; Samuels & Eisenberg, 1981; Perfetti, 1985, 1986). Three perspectives on the relationship between decoding and comprehension will be presented.

Automaticity Theory - Attention is noted to be the heart of the Laberge-Samuels reading model (Laberge & Samuels, 1974; Samuels & Eisenberg, 1981). While attention is described as a renewable resource, it is at any one moment viewed as limited with respect to how much attention is available for text processing. In that each of the two chief tasks involved in reading - decoding and comprehension - require attention, attention must be allocated with care. The amount of attention allocated to decoding will vary according to the reader's skill. The beginning or unskilled reader requiring a significant amount of attention for decoding, may not be able to perform both tasks simultaneously, and will consequently switch his/her attention. First the reader will concentrate on decoding, and then switch back to comprehension. This switching of attention is time-consuming and interferes with effective comprehension.

Samuels (1979) traces the development of word recognition through three stages. The first may be called the non-accurate stage, or stage of acquisition. At this point the reader may have difficulty recognizing words, directing a great deal of attention to the storage and retrieval of sound-symbol relationships. This difficulty persists even when considerable time for decoding is allowed. The second stage is the accuracy stage. At this point the student is able to recognize the word with accuracy, but must continue to devote considerable attention to the decoding process. Such a reader, when reading orally, may read in a slow and halting manner, and may demonstrate limited comprehension of what he has read. The final skilled stage is the automatic stage. This most advanced level is characterized by quick and accurate identification of the words read; little or no attention is required for decoding. Oral reading demonstrates good expression and a rate equal to or faster than a speaking rate. As most of the attention is then freed from decoding, the child is able to focus most attention on the comprehension task; comprehension will thus be facilitated.

Thus the automaticity hypothesis provides an explanation of why the reader who is expending considerable attention on decoding, has little attention in reserve for the higher-level comprehension processes. The educational implications of the automaticity hypothesis have received attention for remediation of reading difficulties, in that one way to effect improved comprehension may be to automatize the pupil's decoding performance. This has been achieved by means of a strategy referred to as repeated reading (Samuels, 1979). By reading and rereading a passage to a satisfactory level of fluency, the child gradually overcomes the decoding barriers within that passage. Attention is concentrated on the decoding task for the first readings, and as the decoding becomes more effortless, the attention is switched to meaning. Gradually the reader moves from effortful decoding, through the accuracy stage, and into the automaticity stage. As he/she requires less attention for the decoding process, more attention is freed for comprehension. Samuels employs the sports or music analogy to support or explain his theory, noting that accomplished athletes or musicians must practise their skills many times before effortless performance is able to occur (Samuels 1979, 1981).

<u>Chall: Reading Stages</u> - Chall's five-stage model of reading development (1983) also supports the reader's gradual development toward fluent reading, with an emphasis changing from decoding to comprehension, as fluency develops. The reader is viewed as performing different

acts as he/she moves through the five stages, demonstrating a gradual increase in the rate of reading. During the first stage of initial decoding, the reader is said to be "barking at print" (p. 39), concentrating primarily on the decoding task, reading labouriously and haltingly, regardless of whether the reader has been taught by a sight word or phonic approach. In the second stage, the development of fluency begins, as the reader begins to use decoding skills and contextual analysis with more confidence. In stage three, the reader moves from learning to read to reading to learn. That is, freed from the demands of learning decoding skills, the reader is now able to concentrate more on reading for meaning. Stages four and five move the reader into more difficult material, in which the reader reads, evaluates, and synthesizes information at advanced levels. Each stage is dependent upon mastery of the previous one, and there is a concern that failure to develop accuracy and fluency during stages one and two will present the reader with an impediment to comprehension, when more difficult materials are presented. Chall (1989) warns that a deficiency in word recognition will impede not only early progress in reading, but also the later development of reading comprehension. Chall recommends that phonics be an important component of the reading program in order to prevent reading problems, especially for high-risk students.

As has already been indicated, many learning disabled populations plateau at a fourth or fifth grade reading level early in high school and demonstrate no further progress. Snider and Tarver (1987) point out that this coincides approximately with the beginning of Stage III, thus seriously hampering the students′ ability to use written materials as a means whereby to develop their vocabulary skills and knowledge and skills base. The resultant impoverished knowledge and skills base may then exert a further detrimental effect on the reading comprehension of poor readers, as these students will have less prior knowledge upon which to build, when faced with new knowledge. Consequently, Snider & Tarver call for an instructional emphasis on automaticity of word recognition.

Verbal Efficiency Theory - Perfetti (1985, 1986) has developed a model that focuses on attentional processes, as does the Laberge-Samuels model. He states that comprehension is limited by the efficient operation of the processes involved in reading. Some of these processes may be lexical access (the recognition of the word), the formation of semantic propositions (basic units of meaning), integrating the semantic propositions as the reading proceeds, and creating a model of the text (deciding what the reading selection is about). The processes that facilitate word identification, if relatively effortless and automatic, will be relatively undemanding of processing resources that are shared with comprehension processes. The theory includes a product/ cost relationship. Perfetti notes that the capacity of working memory is static. Any outcome during the reading exercise is limited by the cost involved in attaining that outcome. If the quality of the processing outcome (reading comprehension) is good, in relation to the cost of the processing resources, the exercise is said to be efficient. The reader who has to make use of contextual cues in order to access the meaning of a word in long-term memory, is making considerable demands on short-term memory. Hence, working memory resources are to some extent decreased or depleted, and comprehension ability is impaired. If the reader is able to reduce, through practice, the resource demands of one of these processes (e.g., lexical access), the attentional capacity for other processes is increased, and these processes are able to operate more efficiently. This theory suggests a high correlation between poor comprehension and inefficient lexical access processes.

The processes described in the verbal efficiency theory have been observed to occur as predicted, both for normal readers and for low achieving readers. In a comprehensive discussion referring to various studies, Perfetti (1985, 1986) was able to show that low-ability readers demonstrated slower and less accurate basic word identification rates than high-ability readers. Genuine word-processing rate differences between high- and low-ability readers for words and letter strings were noted. The difference in latency between skilled and unskilled readers was more noticeable for low frequency, longer words and pseudowords. Low-ability readers required more time to access a word and activate its name code and its meaning, and were unable to take advantage of orthographic structure as well as high-ability readers. Lexical access was demonstrated to be more effortful for low-ability readers, and contributed substantially to reading times. Indeed low-ability readers required more time to process a sentence than their more skilled counterparts. They were aided by context in naming words, as were higher-ability readers, when their basic word identification processes were slowed down. When context was deliberately misleading differences between skilled and unskilled readers increased, with unskilled readers making more errors. Perfetti (1985) describes experiments indicating a clear link between the processes of lexical access and comprehension ability. Quick and effortless word identification reduced the effort required to comprehend the text.

Perfetti (1986) indicates that reading problems independent of word identification problems are relatively

rare. Yet Samuels (1981) does caution that automatic decoding does not guarantee good comprehension. A number of reasons for comprehension weaknesses independent of decoding ability are suggested. Perfetti (1986) indicates that poor listening comprehension is often evident. Stanovich (1982b) points to deficient syntactic ability as a possible contributing factor. Short-term memory problems have also been implicated, as comprehension processes depend on short-term memory to temporarily hold information (Stanovich, 1982b). And Otto & Smith (1983) suggest that for some students, the lack of specific comprehension strategies may also limit comprehension, even for the child who has achieved automatic decoding of text.
Stanovich (1982b) states that poor readers may display comprehension deficits due to the lack of use of metacognitive strategies. That is, such readers appear to be passive learners (Torgesen, 1977), not actively making use of strategies in order to facilitate learning. This may be susceptible to training (Torgesen, 1977; Hansen & Pearson, 1983; Wong, 1980).

But it appears clear that what most distinguishes the skilled and unskilled reader is context-free word identification (Perfetti, 1985). Perfetti suggests that speeded and more automatic word recognition is in order. Perfetti notes that speed of reading may be a consequence of overlearning, and that as such, speed may be a reliable predictor of comprehension. However, before one can plan to develop the reader's speeded and more automatic word recognition, it is necessary to understand the processes involved in word recognition. Several theories will be presented.

Perspectives On Word Recognition Processes

There are different views as to how the word recognition processes are driven. Stanovich (1980) and Perfetti (1985) include comprehensive discussions outlining the differences in the "bottom-up", "top-down", and interactive models of lexical access. In "bottom-up" processing, visual analysis, by means of visual inspection of the letters on the page, moves upward toward identification of the word. Detection of the lines and angles leads to identification of letters. This facilitates the identification of letter clusters, and then upward toward word identification, and ultimately, sentence meaning. Higher -level processes are seen to feed on lower-level processes. Supporters of the "bottom-up" approach state that the poor reader is more reliant on lower-level visual information. This approach does not allow for the effect of higher-level processes, such as the use of semantic and syntactic cues, on the other lower-level processes.

Proponents of the "top-down" model reject this perspective, arguing that the reading process is not likely to be primarily driven by such lower level processes. In the "top-down" model, the context of what is being read, both in terms of semantic and syntactic cues, may activate the word in long-term memory, and the visual stimuli merely serve to confirm the reader's hypothesis. The fluent reader is viewed as developing hypotheses as he/she reads, sampling only a minimum of visual stimuli in order to confirm these hypotheses. The reading experience is thus driven primarily by higher-level conceptual processes.

Stanovich (1980, 1982a) and Perfetti (1985) reject the view of bottom-up theorists who hold that higher-level processes must await the completion of lower-level ones. Stanovich points to the poor readers' use of context to facilitate word identification as support for this rejection. For example, a child who has not mastered orthographic patterns may rely more heavily on contextual cues. He cites research to support his argument, indicating the poor reader's slow and non-automatic word recognition skills make necessary the use of higher level processes to compensate for the deficiencies in lower level processes. However, this is not performed without cost, using up cognitive capacity which might otherwise have been utilized for higher level comprehension processes. This trade-off of cognitive resources is compared to the limited attention available, in the information-processing models of Laberge and Samuels (1974) and Perfetti (1985).

The notion of the top-down theorists that the good reader's performance is less dependent on visual information and more dependent on contextual information, is also rejected. In fact, Stanovich states that the weak reader may be more reliant on context than his skilled counterpart. He suggests that the difference in the use of context is that poor readers use context to facilitate word identification, while good readers use it to facilitate the monitoring of comprehension. Evidence is presented which supports the unskilled reader's use of higher-level processes, and the skilled readers's ability to identify words free of context. Stanovich presents the skilled reader as one whose word identification is primarily data-driven. He notes that the need for context facilitation decreases as fluency increases. Stanovich argues that this evidence tends to negate both the bottom-up and top-down models of word identification.

Instead, Stanovich and Perfetti support the interactive model which argues instead, that both lower and higher level information travel simultaneously in bottom-up and top-down directions, interacting and driving each other to facilitate word recognition. Each level of processing is not seen simply as data for the next level. Rather, various sorts of knowledge: lexical, orthographic, semantic, and syntactical, interact to facilitate the word identification process. To this model Stanovich adds a compensatory process, stating that a deficit in any particular process will result in increased reliance on others.

Examples of the processes which may take place in this interactive model of lexical access may clarify this model. The reader may travel various routes in his attempts to identify and comprehend a word. A child may automatically identify the word on the basis of its visual features or characteristics (house = a place where somewhere lives). He/she may attempt to consciously convert the visual features to a phonological, or auditory representation, and thus try to access meaning (house = h/ou/s = a place where someone lives). He/she may use syntactic cues, from the structure of the sentence. (The child may subconsciously be aware that a word following <u>the</u> is the name of an object, and thus would be inclined to favour house as a response, over her or hate). He/she may use semantic cues, developed from his/her background knowledge of the subject of the reading selection, and/or the model of the text he/she is constructing during the reading process (That man said he was going home for supper; he must be going to his house; the word must be house). He/she may use a combination of all or some of these cues. The significance of any one of these sub-processes over another may vary according to the ability of the reader, the difficulty of the text, or the reader's familiarity with the subject matter. Perfetti suggests that a high quality word representation rich in visual, auditory, semantic, and syntactic features, is the most important property of the reader's word identification system. Stanovich concludes that the goal then, for poor readers, would be a move toward more rapid and context-free word identification. Stanovich suggests that the research points toward more than a correlational relationship between word decoding and comprehension; he suggests the relationship may be causal.

Achieving Automaticity In Decoding: Delivery Methods

The preceding discussion points to the need to develop quick and effortless decoding skills for unskilled readers. A question exists as to which is the optimum delivery model to achieve the desired automaticity of decoding. Two remedial perspectives have been recommended as applications of the automaticity hypothesis and verbal efficiency theory. One is a holistic approach known as repeated reading. The other is a remedial approach which seeks to train the component reading subskills, involving the overlearning of letters, syllables, and words, presented in isolation. Thus the former remedial technique involves the development of decoding skills in context, reflecting the interactive model of word recognition, while the latter is more representative of a bottom-up, or componential code-oriented approach.

Repeated Reading -Repeated reading is a reading strategy that is rooted in earlier centuries (Samuels, 1979). It received renewed interest about one decade ago, as part of the work of Samuels (1979) and Chomsky (cited in Fiedorowicz & Trites, 1987). The technique grew out of the information-processing model proposed by Laberge and Samuels (1974), which proposes that automaticity of word retrieval is a basic requirement for effective comprehension. At that time Samuels and Chomsky appeared to be achieving success with beginning and unskilled readers in improving reading fluency; the method appeared promising.

Samuels (1979) suggested that actual reading practice may be conducive to the goal of achieving automaticity. He noted the positive effects of repeated reading on the fluency of children experiencing difficulty in reading, mentally retarded students, and students of average cognitive ability demonstrating word-by-word reading. He emphasized the need for a minimum reading speed, which appears to be a natural by-product, or evidence of, speeded word recognition. Passages of 50 - 200 words were read and reread until a minimum criterion of 85 words per minute was attained. Samuels emphasized speed over accuracy, indicating that an emphasis on accuracy may indeed contribute to the halting, word-by-word reading style of the nonfluent reader. Samuels reported that the process of reading and rereading facilitated the automaticity of decoding; students were observed to achieve success in developing fluency. Although the focus was on speed, accuracy was noted to develop as a result of more fluent reading. Samuels argued that improvement in fluency would lead to improvement in comprehension, and recommended repeated reading as a supplement to the reading program.

Shortly following this renewed interest, articles speaking directly to classroom teachers, such as one by Lauritzen (1982), indicated an acceptance of this technique by classroom practitioners. However, criticisms were being made with respect to lack of good research methodology to support its use (Moyer, 1982). While it was suggested that the method effected improved comprehension (Samuels, 1979), the theory relating automaticity of decoding to comprehension gains, as well as questions investigating possible modes of implementation, were considered to be in need of additional research (Carver & Hoffman, 1981; Moyer, 1982).

Since that time, research has supported the efficacy of repeated reading. Dowhower (1989), in a review of research findings probing the use of repeated reading, provides a concise summary of its effects on fluency and comprehension, as indicated by recent findings. Both reading rate and accuracy increased significantly as a result of reading the same passage, whether the reading was assisted or unassisted (Carver & Hoffman, 1981; Herman, 1985; Rashotte & Torgesen, 1985; Samuels, 1979). The practice of one passage to a specific speed criterion led to increases of speed and accuracy in new unpracticed passages (Carver & Hoffman, 1981; Dowhower, 1987; Herman, 1985; Samuels, 1979). Assisted and unassisted repeated reading appear equally effective in improving speed and accuracy (Dowhower, 1987). As well, either technique significantly increased reading comprehension (Dowhower, 1987; Herman, 1985; O'Shea, Sindelar, & O'Shea, 1985). Comprehension gains appeared to transfer to new, unpracticed text, provided the passages were at the same reading level, and speed and accuracy had continued to improve. Accuracy and comprehension demonstrated the best gains when students practiced a series of passages, rather than just one passage (Dowhower, 1987).

The method has provided success to a diverse group of readers. Average grade two readers who were word-by-word readers (Dowhower, 1987); learning disabled primary junior division students (Rashotte & Torgesen, 1985); learning disabled junior and intermediate level students (O'Shea, Sindelar, & O'Shea, 1987); less able, nonfluent intermediate-grade students (Herman, 1985); and unskilled high school readers (Carver & Hoffman); were able to achieve gains in fluency and/or comprehension, as a result of their repeated reading experiences.

The literature indicates that the repeated reading strategy responds to the needs of children in committing words to long-term memory. Studies have shown that readers require a high number of repetitions involving a word, before the word can be accurately and automatically recalled. A study involving learning disabled and mildly retarded elementary students in a special education resource program, conducted by Hargis, Terhaar-Yonkers, Williams, and Reed (1988), indicated the mean number of repetitions to recognize 16 words was 50. Words presented in context required 12% fewer repetitions; the learning of low imagery words (idea, belief, fun) was more facilitated by context than high imagery words (tree, chair). However, most prepared classroom reading materials are planned for the needs of non-handicapped readers. Hence it is unlikely that the unskilled reader will be able to obtain the level of repetition required to attain automatic word retrieval (O'Shea & O'Shea, 1988), unless reading materials and strategies are adapted.

Unfortunately, although Allington (1983) notes that fluency has been demonstrated as basic to comprehension, it is not normally treated. While skilled readers receive more opportunities for reading, and are encouraged to read with expression, poorer readers often struggle with materials that are too difficult for them, and tend to avoid reading experiences. Normally, repeated reading of units larger than the word, phrase, or sentence level is not part of the instructional program (Moyer, 1982). Indeed, the instructional programs of unskilled readers often focus on sound/symbol relationships rather than connected text, and on reading accurately, at the expense of fluency (Allington, 1983).

Perfetti (1985) notes a number of differences between spoken and written language. One of interest to this topic is the fact that in speech, prosodic features (appropriate phrasing, lack of inappropriate pauses, appropriate length of phrasal units, etc.) provide the listener with clues as to the speaker's meaning. This cue is absent in written language, presenting to the inexperienced or lower ability reader especially, a barrier to effective comprehension. Dowhower (1987) found that the process of repeated reading facilitated the reader's ability to organize the text more effectively. Observations of the oral reading performance of students indicated improved and more appropriate phrasing. Comprehension, as well as reading rate and accuracy, were positively affected.

As well, this approach appears to be supported by the interactive-compensatory theory. Perfetti (1985) concluded it was imperative that students learn something about decoding, in order to facilitate effortless word identification. He noted that decoding must be more than accurate; it must be efficient. A word may be represented in long-term memory in terms of its visual, auditory, and semantic features. To facilitate efficient word retrieval, a high quality representation is encouraged. Such a high quality representation occurs if a word in long-term memory is rich in visual, auditory, and semantic features. Any weakness in any of the points in this storage system will hamper the efficiency of the retrieval of any particular word from long-term memory. If the reader has considerable information in all of these storage areas, and has developed numerous links or associations between them, activation of the word in question will be facilitated, and hence word identification will be relatively effortless and automatic. Thus stressing the visual and auditory features of a word, independent of its semantic context, may result in the omission of encoding of its relevant features, or associations between these features, that may be instrumental in the identification of the word. Care must be taken in the manner in which a word will be stored in, or retrieved from, long-term memory.

It may be reasonable to suggest that reading in context, through repeated reading, may assist in the building up of visual, auditory, and semantic features, and the associations between these features. Kann (1983) indicates as well that it can foster knowledge of syntactic patterns. Perfetti (1985) noted that reading itself has the potential to bring about learning to read. And repeated reading, performed in context, may help the student build such a rich word representation, while allowing the reader to compensate for decoding weaknesses by the use of contextual cues, as he/she strives for automaticity.

And finally, the strategy may impact positively on the reader's affective needs. Kann (1983) indicates that the increased fluency acquired by means of repeated reading provides the reader with successful experiences, which give the student a sense of progress and confidence. When the reading is modelled, or assisted, it allows the student access to materials he/she may otherwise not be able to experience.

Component Decoding Skills Training - The second remedial perspective based upon the automaticity and verbal efficiency theories is the training of component reading skills. Otto and Smith (1983) describe a tension between two conflicting perspectives of teachers' conceptions of the reading process. These authors note a recent shift toward a "meaning-centered" model of reading which views reading as a unitary process that cannot, and should not, be broken into component parts, or skills. Emphasis of instruction is placed on the ultimate product of the reading exercise: comprehension. The implications for instruction include a decreasing emphasis on the diagnosis and treatment of specific weaknesses, such as decoding skills. Indeed, Chall (1989) suggests that many hold the view that meaning-emphasis programs will lead to greater appreciation of reading, as opposed to the boring and repetitious exercises associated with code-oriented programs.

The other perception of reading instruction is one that is "skill-centered". This perspective of the teaching of reading presents the reading process as a collection of separate but interrelated skills. The model suggests that the reading process can be dissected into its component skills, in order to be taught to beginning or struggling readers. Chall (1989) recommends that for beginning readers and those at greatest risk for reading failure, a code-oriented program is basic to helping children to become effective readers. Such a code-oriented program aligns itself with what is described by Otto and Smith as the "skill-centered" model. Thus by identifying the crucial component skills of reading, and by teaching those required by the student, remediation of reading difficulties may occur.

Bateman (1979) refers to task analysis as the process of determining which specific component subskills must be taught. She points to one task-analytically derived reading program which has been proven to improve the reading achievement of low-achieving populations subject to poverty, or who were bilingual or at high risk due to other factors. The Distar program, developed by Engelmann and Bruner (cited in Bateman, 1979), identified four components basic to word reading: symbol identification, symbol sequencing, analysis and synthesis of the phonemes of words, and rhyming. These four skills are taught to mastery in the Distar program. Higher-level versions of Distar go on to more difficult decoding skills, as well as comprehension skills. Such reading programs do not focus on children's assumed psychological weaknesses, but rather on what are considered to be the real and observable prerequisite skills for reading.

Direct instruction is another product of the view that task analysis must isolate and sequence the skills required for reading success. Carnine and Silbert (1979) devote an entire comprehensive work to the specific skills to be taught throughout the various grade levels, indicating that the efficacy of this approach has been demonstrated through research. Goodman (1985) and the United States Department of Education (1986) indicate that direct instruction incorporating structured and sequenced materials and activities, are indicators of effective instruction.

Carnine and Silbert (1979) suggest that it is the duty of the instructor to be aware of the skills comprising the reading process, and the procedures whereby to effectively teach these skills. They suggest that children cannot become successful readers unless the deficient skills of struggling readers are identified, and direct instruction focussing on these weaknesses occur.

Otto and Smith (1983) have suggested that a quiet but real trend away from "skill-centered" to "meaning-centered" remedial reading programs has taken place. And yet, at the same time, support for the training of component skills is still in evidence (Bateman, 1979; Carnine & Silbert, 1979). Some of the most recent research has once again placed a strong focus on the need for the development of the component skills of reading (Boder, 1982; Doehring et al., 1981; Fiedorowicz & Trites, 1987; Lyon, 1985). This focus on the training of component reading skills has been combined with an interest in subtypes of reading disability.

<u>Subtypes of Reading Disability</u> - The past two decades have witnessed a rejection by many that a reading disability is unitary in nature or etiology (Doehring et al., 1981) and a simultaneous ongoing search for homogeneous subtypes of reading disability (Boder, 1982; Doehring et al, 1981; Fiedorowicz & Trites, 1987; Lyon,

1985; Satz & Morris, 1981). There is a search for clarification of what has been a complex and as yet not well understood condition, in order that the identification and suitable programming for reading disabled individuals may be facilitated. Traditional single factor theories such as the perceptual deficit hypothesis, which point to one single explanation of reading disability, are being rejected as too simplistic (Doehring et al., 1981). Reading is described as being too complex a process to be confined to a single explanation for all observed problems. These authors suggest that traditional investigations were based on the assumption that all reading disabled children were part of a homogeneous group, and thus focussed research on finding a single cause for the disability. The authors concur with Vellutino (1980), that single factor theories have yet to be verified in methodologically sound studies.

As the nature of reading disabilities is complex, it is argued that its treatment cannot be simple either. Doehring et al. argue that the wide range of difficulties in reading cannot be remedied by any one holistic remedial technique. Lyon (1985) indicates that samples of learning disabled children vary significantly in their development of the skills that are related to reading development, and suggests that it is logical that children who read poorly for various reasons cannot respond equally successfully to one teaching strategy or approach. Various authors, by analyzing the patterns and/or interrelationships of achievement, linguistic, and neuropsychological performance, have identified subtypes of reading disability and have at times also attempted to recommend programming according to the student's identified subtype.

Two approaches to the determination of subtypes have been in evidence: subjective and objective (Fiedorowicz & Trites, 1987). The work of Boder and Jarrico (1982) and Doehring et al. (1981) can respectively serve to illustrate the operation of the two approaches to subtypes, the nature of the subtypes, as well as the manner in which the subtype identification suggests subsequent training of component functions.

Boder and Jarrico (1982) notes three different types of reading disabilities on the basis of observed behaviour in reading and spelling tests: dysphonetic (unable to phonetically analyze a word, relied on sight to read or spell); dyseidetic (analytic skills were unimpaired, but were unable to perceive auditory or visual gestalts in spelling and reading); mixed dysphonetic-dyseidetic (deficient in phonetic analysis and visual and auditory gestalts). Dysphonetics are seen to demonstrate auditory component deficit functions, dyseidetics demonstrate visual component deficit functions, and mixed dysphonetic-dyseidetic demonstrate a combination of component deficit functions in both the visual and auditory channels. Boder points out that identification of the dyslexic reader's subtype enables those concerned with his/her remediation to anticipate and cater to the component deficit functions which require attention. For example, she suggests that dysphonetic dyslexics may be hampered by deficits of the auditory channel, hampering the reader's ability to segment a word into its component syllables, and blend letter sounds into syllables, or syllables into words. The teaching of specific skills is recommended in order to remediate each subtype. For example, oral syllabication and syllable-by-syllable phonetic writing is recommended for the dysphonetic readers. Boder recommends that instruction should vary according to the observed strengths and weaknesses of each of the subtypes, with the instructor initially teaching to the student's cognitive strengths, in order that the student may experience success as the remedial program begins. She stresses that training must respond to the student's individual needs, achieved possibly by means of grouping children according to their reading subtypes and level of reading achievement.

Of more recent origin is the objective approach to the search for homogeneous subtypes of learning disability. This has been achieved by means of empirical statistical approaches facilitated by developments in computer technology and multivariate statistical techniques (Fiedorowicz & Trites, 1987; Satz & Morris, 1981). These statistical techniques facilitate a more objective classification, through their use in searching for a hidden underlying structure in complex data (Satz & Morris, 1981). Fiedorowicz and Trites trace the development of the objective classification of subtypes by a number of researchers, including Doehring (1977, 1979, 1981), Rourke (1979), Satz (1981), Lyon (1981, 1982) and their associates (as cited in Fiedorowicz and Trites, 1987).

The subtypes generated by the Doehring group are described in detail, as they form part of the theoretical base of the present research study. The Doehring et al. associates (1981) devised a task analysis of the reading process, and administered a battery of reading tests that reflected this analysis. Three differential reading profiles of reading disabled students were identified. The three subtypes were identified as Type O (Oral Reading), which was characterized by poor oral reading of letters, words and syllables; Type A (Intermodal Association), predominantly impaired by auditory-visual matching of letters, syllables, and words; and Type S (Sequential), demonstrating difficulty in responding to pronounceable sequences of letters as units. In view of current theory suggesting that reading is a complex process, in which cognitive, linguistic, and neurological abilities interact during the reading process, neuropsychological and language batteries were also administered to investigate how patterns of reading skill deficits might interact with patterns of cognitive and linguistic deficits, in different types of reading disabilities. While the majority of subjects with reading problems demonstrated language deficits, there were no clear-cut linguistic correlates of each of the three types of reading disabilities. A number of neuropsychological and linguistic characteristics were described for each of the reading subtypes. In analyzing the results of the language test battery, the authors felt they had confirmed their hypothesis that reading disabilities would likely interact with lower-level rather than higher-level language skills. All three subtypes of reading disability demonstrated impairments in phonemic-level abilities: for example, phonemic segmentation-blending and morpho-phonemic knowledge.

A great deal of enthusiasm has been generated for the multiple syndrome model, introduced to the reading disability literature some twenty years ago. It is viewed as coming closer to the complex realities of reading (Fiedorowicz & Trites, 1981). This enthusiasm is tempered by problems with the manner in which the subtype research has been conducted, thus casting doubt on the validity, reliability, or utility of the identified subtypes (Doehring et al., 1981; Fiedorowicz & Trites, 1987; Lyon, 1985; Satz and Morris 1981).

Fiedorowicz and Trites (1987) indicate that the initial research interest has been subjective in nature, and hence is faulted. The interested reader is referred to the reviews of the subjective approaches to subtypes by Fiedorowicz and Trites (1987) and of clinical approaches by Satz and Morris (1981) for a detailed analysis of the strengths and weaknesses of these earlier studies. A brief discussion of the Boder subtypes may serve to illustrate some of the chief criticisms. Satz and Morris (1981) criticize this work as it was derived to the greatest extent from clinical impressions. They question whether visual inspection is adequate in identifying these subtypes and recommend replication and objective statistical analysis. As well, Satz and Morris (1981) note that Boder did not use a control group, making one question whether the subtypes are idiosyncratic to the group under study, especially if that group has been selected according to predetermined criteria, such as the exclusionary criteria for dyslexia. Thus one cannot determine from such a study whether the subjects of this population read or spell qualitatively and quantitatively different from a normal population. Indeed, Bruck (1988) in a study of dyslexic children, demonstrated that dyslexic children do not exhibit idiosyncratic patterns of impairment in how they process written language. A difference in observed spelling or reading performance was described to be quantitatively, but not qualitatively different. Boder attempted to validate the subtypes by referring to those in other studies which appeared similar. Satz and Morris (1981) warn that subject selection, sample size, assessment batteries, and the meaning of descriptive terms such as language disorder, vary according to each study, making resemblances to other subtypes questionable.

However, even with the advent of objective approaches to subtypes, a number of problems with respect to the subtype literature continue to be of concern. Certainly one problem that has been associated with the subtype literature has been the lack of consensus as to the number and the nature of the subtypes (Lyon, 1985). For example, a review by Fiedorowicz and Trites (1987) indicates that while Doehring and his associates were able to identify three subtypes, Lyon and associates identified six (1981) and five (1982), Rourke and associates generated three (1979), and Satz and associates generated five (1981). This diversity may be a function of the types of measures utilized: the Doehring group classifications were based on reading, language, and neuropsychological tests; the Rourke group used neuropsychological tests, the Satz group achievement and psychological variables, and the Lyon group chose first, language and perceptual tests, and second, neurological and achievement measures. Lyon (1985) suggests that the majority of studies have not been replicated because of the fact that various researchers come to the study with a wide variety of theoretical assumptions and measurement batteries. For example, one's understanding of the reading process, which has already been indicated as complex and perhaps not fully understood, will cause the assessment instruments to be chosen accordingly. Thus two researchers with different views of the reading process may choose two different combinations of instruments.

Other concerns with respect to the various objective approaches include failure to use a control group of normal readers, subdivision of good and poor readers prior to analysis, external validation of subtypes by comparison to other studies, and sample sizes (Satz & Morris, 1981). As well, while the criticism of the subjective subtype studies have been alleviated somewhat by the use of more sophisticated statistical analysis, statistical procedures and measurement approaches do vary from study to study. Indeed, Lyon (1985) cautions that the ability of these statistical procedures to identify accurate subtypes depends upon the researchers's ability to select appropriate assessment instruments and data analysis procedures.

Other hypotheses have been put forth as an explanation for the variability of the subtypes suggested. Some have questioned whether the observed subtypes may in fact differ due to differences in experience or educational strategies to which the child has been exposed (Bruck, 1988). Indeed, Lyon (1985) suggests that subtypes may be validated by determining whether they respond to specific teaching procedures.

Doehring et al. (1981) do caution that the number and types of tests, the population sampled, and the method of classification may make a difference in the types of reading disability types identified. Lyon (1985) cautions that these studies are just exploratory, as do Fiedorowicz and Trites (1987), who indicate that much more research is required. These authors point to the need for more collaboration and pooling of resources and talents in attaining a more consistent pattern of subtypes. On the basis of the work of the Doehring group, Fiedorowicz and Trites set out to assess the efficacy of training procedures selected on the predominant deficits of the three identified subtypes.

Charging that remedial reading programs are often ineffective, Fiedorowicz and Trites (1987) set out to develop a component skills training program that might incorporate both the subtype and automaticity theories. As Doehring et al. (1981) had noted in their study that reading disabilities are not the result of deficiencies in higher-level linguistic abilities, these researchers felt that children's reading ability might best be maximized by the assessment and training of lower-level coding and word recognition skills, through a code-oriented, or "bottom-up" approach. This approach appeared to receive support in Laberge and Samuel's model in which overlearning of sound/symbol relationships to the point of automaticity, would facilitate comprehension. As well, it reflects the stages of reading presented by Chall, in which the early stages involve the acquisition of lower level decoding skills to facilitate comprehension in the later stages. As Fiedorowicz and Trites believed the development of component skills to be important to reading ability; the reading of letters, pronounceable nonsense syllables, and one-syllable words were recommended as the target for accuracy and speed of response. Accuracy was to be achieved first, followed by an attempt to improve the speed of response.

A computer program entitled Autoskill Component Reading Subskills Program (Fiedorowicz & Trites, 1985), based on Doehring et al.'s (1981) subtype classification scheme, was developed. This program serves both to facilitate the subtyping of the student and to provide the remedial program, as required. The training strategy involves first increasing the accuracy of response, and then decreasing the latency of the response, for the most deficient component reading skill identified in the subtype identification. Developed for use with a laboratory of ICON computers, it requires a minimum 10 megabyte hard disk storage capacity and work stations with 512 K memory.

The determination of the student's subtype classification is made by following the guidelines for test interpretation of the Autoskill Test Battery (See Appendix 1) provided within the program. The subtests involved were determined on the basis of a task analysis of the reading process. Four types of measures are involved. The Oral Reading, Auditory-Visual Matching, and Visual Matching measures are delivered by computer format. The Visual Scanning measure is a paper and pencil test. No statements of validity or reliability are available; normative data is available only for the Visual Scanning subtest.

The Autoskill training program consists of three separate strands: Oral Reading, Auditory-Visual Match, and Visual Match. Each strand of the testing and training sections consists of 12 to 13 subprograms (See Appendix 2). Each subprogram deals with single letters and specific letter combinations, presented both as one-syllable words and pronounceable nonsense syllables (See Appendix 3).

For each strand, the training begins with the first subprogram listed, and proceeds in a hierarchic fashion to the final program available. Each training block on a subprogram consists of up to fifty stimulus items, to which the student responds either by calling out the answer or pressing a key. In the Oral Reading strand, the pupil views a letter or pronounceable combination of letters on the screen, and calls out a response. The tutor records the timing and accuracy on the computer. In the Auditory-Visual strand, the student responds to an auditory stimulus provided by means of synthetic speech, and responds by selecting one of three visual stimuli on the screen (letters, syllables, or words) by pressing the appropriate key. Finally, in the Visual Matching strand, the student matches the visual stimulus presented at the top of the screen, with one of the three choices seen at the lower end of the screen. In the second and third strands, the computer automatically records the time and accuracy, based on the student's selection. In all three strands, the program provides an indication of success or error; the tutor coaches as necessary.

In order to advance from one subprogram to the next, the student must achieve an accuracy level of at least 96%, and a median latency of 100 msec., on three consecutive trials. In the Oral Reading strand, students will have the option of moving on to graded lists of words, phrases, sentences, and paragraphs, once the first 13 subprograms are completed. The Auditory-Visual Match and Visual Match strands contain only the graded word option. Following each training block, the results are presented in table and graph form, or in detail. If a printer is available, printouts of these results may be obtained. Records for each participant are automatically kept, on an ongoing basis. The training blocks can be individualized as well, by adjusting the period of time available for presentation of the stimuli, length of time that the positive reinforcement is exposed, length of time the correct answer is provided when an incorrect answer has been given by the student, as well as the number of items per block. The Autoskill program appears to make excellent use of the unique individualization and record-keeping features of computer-assisted instruction.

The Autoskill study (Fiedorowicz & Trites, 1987) involved 115 students who met the usual criteria of reading disability, exhibiting a reading delay of at least one year. The students were then divided into three groups. One group was to be trained on Autoskill; the second group served as an untrained control group. The third group was trained on computer programs concerned with some aspect of language arts development, to control for possible influences of the use of computer technology. The Autoskill and untrained control group were subtyped after administration of the Autoskill Test Battery; the alternate computer-trained (ACT) group was not. A subsample (n = 24) of the Autoskill group was matched with the ACT group. Students in the Autoskill program were trained individually, by a teacher or research assistant. Students in the ACT group worked on a computer program of the teacher's choice, although not necessarily with the support of individual training. Students in the untrained control group received whatever program had been planned for them by the school board.

The Autoskill training took place during one school year, from October through May, for a total mean number of 56 hours. The Autoskill and Untrained Control Group were pre- and posttested at the same time, in September and May/June. The ACT group received a mean of thirty hours training, and was posttested along with a matched subsample of the Autoskill group, after 30 hours of training.

After the training period, the Autoskill-trained groups demonstrated significant gains on measures of word recognition, phonetic knowledge, and paragraph reading fluency and comprehension, as compared to the other two groups. It was demonstrated in an earlier pilot study that a training period of approximately 21 hours was necessary to achieve significant improvement of word recognition skills and phonetic knowledge (Fiedorowicz, 1983, cited in Fiedorowicz & Trites, 1987). This study (Fiedorowicz & Trites, 1987) noted that 56 hours was required to effect significant positive results in the comprehension of paragraphs.

Several concerns related to the study must be expressed. First, while the authors suggest that the identification of the three subtypes is objective, one may question the practicality of the subtyping exercise for practitioners in the schools. The Autoskill manual that forms part of the computer program (Fiedorowicz and Trites, 1985) provides guidelines for the subtyping exercise. However, interpretation of the guidelines may indeed be a subjective exercise, and it may at times, depending on pupil performance on the subtest, be difficult to classify the student in one subtype or another. Indeed, the four judges independently classifying 91 of the experiments's subjects, were unable to arrive at a consensus for 17 of those subjects (Fiedorowicz & Trites, 1987). Should the subtyping be inaccurately performed, subsequent programming may prove ineffectual, if indeed the accurate subtyping is basic to appropriate programming.

The Autoskill computer program was adequately explained in terms of its theoretical background, research base, and structure. However, little was known about the other computer programs used. Teachers were allowed to select from programs recommended by board personnel, or according to their own preferences. One may then question just how much time was actually spent in reading, in the case of the alternate computer controls. Also, it is unclear to what extent subtype tailored instruction or simply general practice in reading, may have facilitated automaticity of decoding. It may be difficult to separate the possibly confounding influence of the two underlying theories.

Another concern with respect to the design of the Fiedorowicz and Trites study is related to factors which may have contributed to the success enjoyed by the Autoskill group, thus possibly confounding the effects of the variables. For example, the Autoskill trained subjects benefitted from individual training of skilled teachers or research assistants. It was not mandatory that those in the ACT group be individually trained. Those in the untrained control group were in regular or special education programs. No information was presented with respect to how many subjects in these groups, if any, received individualized training from a teacher or other skilled adult tutor. Thus whether the gains demonstrated by the Autoskill group are attributable to the superiority of the subtype approach or the individually administered training, is not clear.

The authors presented a remedial technique which effected positive gains in the subjects involved. Whether this gain was primarily attributable to the subtype concept may be moot at this point. The fact that this approach involved training of component subskills is also of interest. Further research on the efficacy of such a skill-centered approach, as opposed to the holistic repeated reading technique, appears warranted.

Peer Tutoring

For the purposes of the present study, the need for individualized tutoring will be met by the use of peer tutors. Tutoring, considered to be one of the oldest forms of instruction, was in evidence as early as the first century A.D. (Osguthorpe & Scruggs, 1986), and is now receiving renewed interest. This interest seems substantiated by strong evidence of its efficacy as an instructional tool.

Devin-Sheehan, Feldman, and Allen (1976) , in reviewing available research data up to that time, suggested that while some research had been attempted, that many of the researchers' approaches were haphazard and unsystematic. While it appeared that tutoring was worthy of the educator's interest, the authors recommended additional and more systematic research. Since that time, considerable work in the field has been accomplished, producing a wealth of research studies, reviews, and recommendations for instructional use of this technique.

The research indicates benefits to be gained by both members of the tutoring partnership. A statistical analysis of 65 individual studies of elementary and secondary school tutoring programs was performed by Cohen, Kulik, and Kulik (1982). Only those studies including a non-tutored control group, and free of serious methodological flaws, were included. Findings indicated that tutoring programs have positive effects on the academic performance and attitudes of tutees. Tutors developed a more positive attitude toward tutored subjects, and gained better understanding of these areas. It was found that the effects of structured tutoring programs were stronger. The quantitative studies did not support however, significant changes in self-concept.

Osguthorpe and Scruggs (1986), in a review of research probing the use of special education students as tutors, conclude that such students are able to function effectively as tutors, providing adequate attention is paid to training and supervision. The authors quote studies (Truesdale, 1976; Mellberg, 1980; Carlton, Litton, & Zinkgraf, 1985) involving learning disabled, disadvantaged, and mildly mentally retarded adolescents, as well as disadvantaged and learning disabled elementary age students. In each of the studies a pre-posttest design, with a control group and random assignment to the groups, was used. In all three studies, tutors and tutees demonstrated greater improvements in reading, spelling, and arithmetic tasks, than controls.

The "effective schools" research also bears out the benefits associated with peer tutoring (Goodman, 1985;

Purkey & Smith, 1983). Tutoring may increase the amount of time the learner is actively engaged with the curriculum. Goodman (1985) refers to academic engaged time (the amount of time the student is actively engaged with curriculum materials at an appropriate level of difficulty), as being a variable that is positively correlated with school achievement. Purkey and Smith (1983) also encourage "maximized learning time", that is - more time devoted to active learning activities. Walberg (1988) points to the amount of time students engage in learning as one of nine educational productivity factors. Indeed, he specifically identifies such programs as tutoring and computer-assisted instruction as a means whereby to allow more "productive time", in which the teacher is able to accommodate individual differences, and provide secondary school students with the time and remedial instruction required to fill academic gaps. Slavin (1983) points out however, that the presence of only one teacher serving up to or more than thirty students, suggests that the percentage of time during which the students can actively participate is low. He recommends student-student interaction as a means whereby to provide this interaction; from this demonstrated need has evolved a new structure of learning in which small groups work together to achieve a common goal: cooperative learning.

Certainly whole group instruction cannot accommodate the wide spectrum of abilities and achievement levels present in any one classroom. While some teachers may cope with the varying levels of pupil ability and readiness by grouping children into smaller groups, it may be difficult to completely eliminate the problems posed by the heterogeneity of any class. Thus it appears possible that some students may be learning material that is beyond them, while others are waiting as known material is being delivered. Delquadri, Greenwood, Whorton, Carta, and Hall (1986), indicate that classwide peer tutoring allows the student increased opportunity to respond to the educational experiences provided within the classroom, without adding to the teacher's workload. Other studies have concluded that classwide peer tutoring is a viable instructional alternative for secondary teachers attempting to meet the needs of a diverse classroom population. This type of tutoring has been demonstrated to be effective in increasing the academic performance of both mildly handicapped and nondisabled students in grade 10 social studies classrooms (Mahheady, Sacca, & Harper, 1988) and in grade 9 and 10 mathematics classes (Mahheady, Sacca, & Harper, 1987).

Jenkins, Mayhall, Peschka, and Jenkins (1974) contrasted the effects of teacher-led small group instruction and instruction delivered to primary and junior age children by cross-age tutors, concluding that learning was greatest in the tutorial situation. All the available evidence suggests that cross-age tutoring appears to be the most logical choice for emphasizing the academic growth of tutees (Osguthorpe & Scruggs, 1986). The evidence targets tutoring as facilitating academic achievement for student and tutor, as well as fostering a more positive attitude toward school work (United States Department of Education, 1986).

Topping (1989) reported on the advantages of peer tutoring as being an effective instructional strategy when structured with children of differing ability. A two year difference in ability was recommended. He specifically recommended a technique known as paired reading, in which the tutor provides stimulation, support, and participation in the reading exercise.

Other studies indicate that cost-effectiveness may be another factor recommending peer tutoring. A study comparing cross-age tutoring and paraprofessional involvement (Armstrong, Conlon, Pierson, & Stahlbrand, 1979, cited in Jenkins & Jenkins, 1985) indicated the high school senior students serving as tutors were able to achieve similar academic gains, at one-third the cost.

Developing Decoding With Computer-Assisted Instruction

The relationship of decoding and reading comprehension has been demonstrated, as has the significance of automaticity of word identification in facilitating the comprehension processes. However, achieving automaticity of decoding requires a great deal of repetition, which may present to the reader a sense of discouragement or frustration, or at the very least, create a feeling of lack of interest or boredom. There is a need for the provision of training which is motivating, and able to provide as much repetition as is required by the individual, over a lengthy period of time. Perfetti (1985) points to computer-based practice as a means whereby to meet these requirements, noting as well the computer's unique record-keeping and feedback features as being obvious and useful advantages.

There is no question that computer technology is becoming increasingly available to the education system today. Computers have been used to aid reading instruction for at least twenty years (Torgesen,1986), and appear useful in remediating specific weaknesses (Balajthy, 1987) or subskills (Cohen, Torgesen, & Torgesen, 1988). Recent evidence provides positive support for the use of computer technology in the reading classroom, and for special needs students. It is able to provide drill and practice that the teacher is personally unable to provide (Rude, 1986). Torgesen, Waters, Cohen, and Torgesen (1988) employed computers as a means of avoiding excessive demands on the teacher's time, and to accurately monitor response speed. It appears especially suitable for strengthening decoding skills to automaticity (Cohen, Torgesen, & Torgesen, 1988; Perfetti, 1985; Roth & Beck, 1987; Torgesen, 1986; Torgesen, Waters, Cohen, & Torgesen, 1988; Warren & Rosebery, 1988). Teachers have especially appreciated the enthusiasm demonstrated by their students in its use (Rude, 1986), and studies have suggested the benefits which have been associated with this higher level of motivation (Keene & Davey, 1987; Roth & Beck, 1987; Warren & Rosebery, 1988). Certainly the computer appears more motivating to students than do standard paper and pencil exercises, providing instead a game format, and instant feedback (Roth & Beck, 1987). An American survey (Cosden, Gerber, Semmel, Goldman, & Semmel, 1987) of special education students in southern California indicates that the students were actively engaged 80 to 85% of the time while working with computers.

Not to be ignored either, are the affective variables which may influence the efficacy of computer-assisted instruction. Illiterate adults using computer-assisted instruction to improve their literacy skills have supported its use for a number of reasons (Turner, 1988). These students appreciated the privacy, patience, instant feedback, and individualization of pace and programming offered to them.

There is a question whether the use of computers might limit interaction and learning of the students, and a suggestion that such a concern must be monitored (Rude, 1986). In fact, limited computer resources in schools (Semmel & Lieber, 1986), and/or teacher practices, often result in the computers being used by pairs of students, facilitating increased social interaction (Balajthy, 1987) and the superior learning to be expected through small group interaction (Slavin, 1983) or tutoring programs (Cohen, Kulik, & Kulik, 1982).

The potential of computer-assisted instruction in providing time-consuming additional drill and practice, individualized programming and rate of learning, ongoing reinforcement and feedback, and record-keeping, has been demonstrated (Cohen, Torgesen, & Torgesen, 1988; Johnson, Gersten, & Carnine, 1987; Rude, 1986; Torgesen, Water, Cohen, & Torgesen, 1988; Warren & Rosebery, 1988). These advantages appear suited to the needs of the teacher, in providing the individualized programming and record-keeping required by a repeated reading strategy. These advantages had been recognized as well by the developers of the Autoskill Component Reading Subskills Program (Fiedorowicz and Trites, 1985). Torgesen (1986) stresses that computer-assisted instruction can be effective when it implements sound instructional practices.

In view of the research evidence supporting the efficacy of computer-assisted instruction, the present study examined the delivery of automatization of decoding skills in this context. Each of the two approaches to the development of automatic decoding skills - repeated reading, and the training of component reading subskills, were delivered in computer format. The latter was presented by the Autoskill Component Reading Subskills Program (Fiedorowicz & Trites, 1985), and the former by means of Read It Again, Sam (Wyatt, 1988).

Rationale

The brief review of the literature identified two distinct remedial perspectives which also share a common theoretical basis - automaticity. Nevertheless, these two approaches differ in two basic respects. Repeated reading focusses on developing decoding skills in context, emphasizing speed over accuracy. The skill-based or componential approach focusses on developing decoding skills in isolation, at the sub-word and word level; accuracy is emphasized first, then speed is targeted. The Autoskill program, by virtue of its emphasis on the overlearning to the point of automaticity at the letter, syllable, and word level, is representative of the "bottom-up" componential approach. Repeated reading, in which decoding is improved in a contextual setting, better represents an interactive model. Therefore it would be appropriate to directly compare the two remedial approaches. Such a study, controlling for common use of research-based computer technology, may serve to indicate the relative effectiveness of one over the other in improving decoding, and ultimately, comprehension.

Another concern that may be addressed is the reliance of each of the programs, on tutor involvement. This is especially true of Autoskill, as either teachers or graduate students were assigned to the pupils for an extended period of training (Fiedorowicz & Trites, 1987). The practicality of such an input of human resources may be questioned by some. Peer tutoring may provide a workable alternative, as it has been demonstrated to effect improved performance and motivation, both for tutors and tutees. Hence an exploration of the issue of tutors may be fruitful in this case, as the vocational student is viewed as losing interest in school, and inclined to leave school without a graduation diploma.

Of additional interest will be the role of computer-assisted instruction in these remedial programs. Their increasing availability in the schools begs additional research, especially in relation to the quality and effectiveness of the software available. Research-based evaluation of such software programs can provide valuable information for the classroom practitioner, and ensure that optimum use of the student's learning time and computer-assisted instruction is being made.

The findings to be gleaned from such a study may demonstrate whether either or both programs deserve to be considered as part of the remedial programs of vocational secondary students' programs, for whom slow and effortful decoding may be impeding their reading ability, and hence threatening the development of their literacy skills.

Statement of The Problem

This study will compare the relative effectiveness of two computer-assisted reading programs, to identify specific aspects of strength in improving the decoding and comprehension of grade nine unskilled readers. It will seek to clarify the following questions:

1. What are the comparative effects of repeated reading (Read It Again, Sam) or component skills training (Autoskill) on reading fluency (decoding, speed, accuracy)?
2. What are the comparative effects of repeated reading and component skills training on reading comprehension?
3. To what extent do differential remedial techniques improve the reading ability of identified subtypes?
4. What are the effects of the program on tutor perceptions of the tutoring role ?

Null Hypothesis

1. No differential effects of repeated reading or component skills training on reading achievement will be noted.
2. Neither remedial procedure will affect reading fluency (decoding, speed, accuracy).
3. Neither remedial procedure will affect reading comprehension.
4. There will be no differential effects for subtypes for either remedial treatment.

With respect to peer tutor effects, an examination of anecdotal observations will form the basis of an analysis of the effects of the programs.

Chapter Three

Methodology

Method Overview

Eighteen grade nine students, identified as unskilled readers by means of teacher nomination and subsequent assessment, were assigned to three matched groups for remedial reading instruction. Two of the groups, with the assistance of grade twelve tutors, participated in either a computerized repeated reading program or the Autoskill Component Reading Subskills Program. The third group received a regular remedial reading program within the classroom. This training program took place in a vocational secondary school, over a three month period, exclusive of pre- and post-testing, in order that each pupil would be able to receive twenty hours of training.

Subjects

Permission was obtained from a public school board in the Niagara region to conduct a study in a vocational secondary school likely to have both a large population of unskilled readers and a bank of appropriate computer resources. Parents of grade nine students identified as possible candidates for the program were informed of the program, and permission for their children's participation was granted.

Initial nomination of a pool of candidates was based on four criteria. Participants in the study must be of average cognitive ability, demonstrate reading achievement significantly below grade level, specifically below grade 6. This specific grade level criterion was chosen as the Autoskill program is recommended and designed for students reading below the sixth grade reading level (Fiedorowicz & Trites, 1987). Additional criteria included: good health, lack of debilitating physical or emotional conditions, and no evidence of truancy.

Students who were to be accepted into the research project were to be drawn from the grade 9 population at the school. The grade 9 students at the school were organized into five English classes. One of these classes was not part of the selection process, as it was a low-functioning class, consisting primarily of educable retarded students. Teachers of the remaining 4 classes were asked to nominate candidates who appeared to satisfy the criteria.

Of the 74 students in these classes, 40 were nominated as potential candidates. The school records of this list of candidates was checked to confirm the above criteria. As each of these students must be declared exceptional in order to attend the vocational secondary school, intellectual assessments were on file. Health and attendance records, as well as progress reports and records of standardized testing, were examined to ensure that the specified criteria were being met. Eleven candidates were rejected at this point based on one of the following - cognitive ability well below the average range, hearing impairment, reading achievement above grade six, truancy, or expected moves out of the school area.

Students selected based on teacher nomination and school records were assessed on a battery of reading achievement tests, as well as the Autoskill Test Battery. The reading subtest of the Wide Range Achievement Test (WRAT) and the reading rate subtest of the Stanford Diagnostic Reading Test (SDRT) were administered to identify those students whose reading achievement was significantly below the sixth grade level, and whose reading rate fell in the bottom quartile. An additional 11 students were rejected at this point as assessed word identification achievement, according to the WRAT, was at or above a sixth grade level. The remaining 18 students who did satisfy the criteria took part in additional testing. The Test of Reading Comprehension (TORC) was administered to obtain a measure of reading comprehension. The Autoskill Test Battery was administered in order to establish a baseline and provide the data necessary for subtyping. Students were subsequently subtyped according to the Autoskill guidelines, and randomly assigned to three groups. The groups were matched on the subject variables including chronological age, sex, assessed intellectual capacity, and subtype classification, as well as dependent variables, including word recognition and comprehension measures to be discussed. Mean student age was fourteen years, nine months, with age range from fourteen years, 0 months, to fifteen years, 0 months. The groups included ten males and eight females. Since 14 computers were available at the school, and the computer room was relatively small, the maximum for each group would be seven students. The preliminary screening process and pretest assessment battery scores resulted in the selection of 18 students, of whom 12 would work in the computer room with tutors.

Tutors

Tutors were nominated by the teacher and administrative personnel, based on reading achievement well above the sixth grade level. A specific class was targeted for the study, as this class was considered the highest functioning grade 12 class in this vocational school. Their English class was scheduled to take place during one of the regular daily openings in the computer room schedule. This time slot was subsequently reserved for the period of the study. The class was made up of 12 male and three female students. Twelve tutors were required; the availability of three additional students allowed for occasional tutor absence due to illness, or competing demands on the tutors' time (work experience and cooperative education). Tutors received partial credit for their grade 12 English program through their involvement in the tutoring experience. Their regular classroom teacher calculated a grade for this involvement, based on the tutors' performances throughout the study. At the end of the study, the tutors' opinions with respect to the two computer-assisted programs and the tutoring experience were solicited. (Refer to Appendix 4)

Instruments

This section will describe the instruments used to select students at pre-test, to evaluate students at post-test, and to conduct training.

Wide Range Achievement Test - The Reading subtest of the WRAT (Jastak & Wilkinson, 1984) is an individual test, consisting of two levels. Level 2 is intended for persons from 12 years 0 months through adulthood. It has been used in studies by Fiedorowicz & Trites (1987) and Torgesen et al. (1988) to establish reading grade level. In this study it was used to determine the pupil's word identification grade level. The authors attribute the WRAT's popularity to its simple design and large sample size. They indicate that the test provides a strong measure of the constructs being studied over the various age groups. Concurrent validity is also reported, suggesting that the WRAT correlates well with other achievement tests, such as the Stanford Achievement Test. Test-retest reliability for the Level 2 Reading test was 0.90. It has been reported that standardization in this revised edition has been improved, and reliability and validity is deemed adequate (Keyser & Sweetland, 1985).

Stanford Diagnostic Reading Test - This instrument (Karlsen, Madden, & Gardner, 1976) is both norm-referenced and criterion-referenced and can be administered in an individual or group setting. Reliabilities range from .79 to .98 for various subtests across levels. The vast majority of coefficients exceed .90 (Buros, 1978). It provides four levels of diagnostic evaluation, with two parallel forms at each level. The Brown level is intended for grades 5 through 8, and for low-achieving high school students. The Reading Rate subtest, administered as part of this study, measures pupils' ability to read easy material quickly, with comprehension. A multiple choice cloze format is used, within the body of the selection. This timed subtest, requiring several minutes to administer, was used to establish comparative data on the three groups' reading rates.

Test of Reading Comprehension - The TORC (Brown, Hammil, & Wiederholt, 1986) is based on the theory that reading is an interactive, constructive language process. It focusses on comprehension and silent reading. This instrument was administered to determine the student's comprehension achievement. It is a group test, suitable for use in the elementary grades, through eighth grade, with norms for high school. As such, it is considered suitable for low-achieving grade 9 readers. Three of the eight subtests were administered: Syntactic Similarities, Paragraph Reading, and Sentence Sequencing. Test-retest coefficients for the subtests selected are .81, .85, and .69 respectively, indicating satisfactory reliability; acceptable construct, content, and criterion-related validity has been established (Reid & Hresko, 1981).

Autoskill Component Reading Subskills Program - This program (Fiedorowicz & Trites, 1985) has been described in Chapter Two. The Autoskill Test Battery was administered prior to, and immediately following, the training period to all students in the three groups. The assessment was administered by qualified teachers trained to perform this task.

Read It Again, Sam - This program (Wyatt, 1988) provides a flexible format in which to organize repeated reading selections. The teacher may enter a set of stories the group of students will be reading, at whatever grade levels are appropriate. The program can be further individualized for each student by programming the computer to present to a specific student a specific set of stories from the total set. For the purposes of this study, 130 passages ranging in difficulty from the second through sixth grade levels were presented (Covell, 1966; Gersten, 1981; Gibb & Talpiainen, 1974; Thomas, 1969), set at a length of 200 words. Readability levels have been established for the selections, according to the Dale-Chall readability formula. In addition, ten passages were checked by the Fry Readability formula to confirm the authors' identified grade levels (Fry, 1977). For the purposes of this study, stories were entered as indicated:

Grade 2 - 2.5 :	10
Grade 2.5 - 3 :	10
Grade 3 - 3.5 :	10
Grade 4 :	10
Grade 4 - 5 :	12
Grade 5 :	10
Grade 5.5 -5.7:	10
Grade 6 :	60

(See Appendix 5 for sample stories)

Procedures

Pretest Phase - Two experimenters who were fully acquainted with all instruments previously listed, trained four teachers to assist in administration of pretest instruments. Training included administration of the computerized Autoskill Test Battery and the WRAT. Appendix 6 contains a summary training guide used to train the teachers to administer the Oral Reading subtest of the Autoskill Test Battery. The remaining two subtests required little training; these are presented by the computer, and accuracy of response is automatically verified and recorded. The teacher need only be present to monitor the testing.

The Wrat and the Autoskill Test Battery were administered in an individualized format. This assessment was administered in two sessions, lasting approximately 30 to 40 minutes a session. The SDRT, the TORC, and the Visual Scanning subtest of the Autoskill Test Battery were administered in group format. The group was divided into two smaller, and more manageable groups, for this purpose. One of the experimenters and one of the trained teachers, who were experienced in the administration of formal assessments, worked together in the administration of these tests. Two sessions, of approximately 45 minutes each, were required.

Tutor Preparation - A three week training block was planned to enable the grade 12 students to become familiar with the two computer programs and record-keeping procedures, as well as to develop their awareness of the coaching skills and interpersonal skills required. See Appendices 7, 8, 9, and 10 for recording procedures used. The teacher normally responsible for the grade 12 students took part in the training session, so that she would be able to act as a resource person during the period of the study. The grade 12 students role-played the tutoring exercise, in pairs, using each of the two pieces of software. Problem-solving discussions took place at the end of each training session, in which questions relating to the technical aspects of the programs, as well as teaching techniques and required interpersonal skills were discussed. Informal spot-checks and short diagnostic tests determined whether the tutors were prepared to implement their duties. Students were required to demonstrate mastery of the Autoskill pronunciation guide (Appendix 3) as well as proficiency in using each of the two computer programs. The study was initiated when all the above steps had been completed.

Training Phase

Training for the two computer groups was conducted simultaneously in the school's computer room. The 12 students and their tutors participated in the program under the supervision of one of the experimenters and the grade 12 teacher. Once training for tutors was completed, the role of the experimenter and the grade 12 teacher was limited to monitoring the program, in order to ensure that the students were on task, and also to be available for questions. There was no direct instruction related to the programs, by either the experimenter or the teacher.

Autoskill Training Group - A group of six students met during the same scheduled period daily, over a three month period, in the computer room at the secondary school. The period was 37 minutes in length. Pupils were required to accumulate 20 hours of instruction, as this was the approximate period of instruction with the Autoskill program required to effect improvement in reading word recognition skills (Fiedorowicz & Trites, 1987). Students worked in the Autoskill strand as recommended by the decisions resulting from the subtyping exercise. However, two students were switched, and deliberately trained in a strand not recommended for them. Days were lost due to professional development and assessment days, special school events, absenteeism, and holidays. Attendance records were maintained in order that students who may occasionally be absent would make up lost time at the end of the training block. Each student was assigned a tutor for each session. The tutor may or may not have been the same individual, depending on absenteeism or other conflicting commitments. The Autoskill training proceeded as described in Chapter 2. The group was supervised daily by one or both of the experimenters, as well as the grade twelve students' regular classroom teacher.

<u>Repeated Reading Group</u> - A group of six students met daily, in the same place, and for the same amount of time, as the Autoskill training group. Attendance records, supervision, and tutor assignment took place in the same manner.

Each student participating in the program required the assistance of a tutor, who recorded reading rate and number of reading errors directly on the computer. The student began by reading the story, with the tutor recording speed and accuracy. The screen then illustrated for the student the time required to read the passage, and the number of errors; the program automatically records the student's progress, in terms of rate and errors. This information can be viewed on the screen or printed. If the pupil achieved 100 wpm on the initial reading, he received positive feedback on the screen, and the computer automatically moved the student on to the next story in the sequence. If the student failed to achieve the criterion, he/she was automatically returned to the same story, for the purpose of rereading until the criterion rate was achieved. Throughout this study, the tutor recorded responses to a set of four comprehension questions, after the first reading.

Just prior to the study, all students were assessed on 5 stories from the program, ranging in reading difficulty from grade two through to grade six. Measures of reading rate, reading errors, and comprehension were recorded to provide an additional initial estimate of reading rate, reading accuracy, and comprehension.

Untrained Control Group - This group of six students took part in a remedial English program offered by the regular classroom teachers, in the classroom. The length of the classes was the same - 37 minutes. The program offered was one that was modified to meet the needs of the students.

Posttest Phase - The entire pretest battery was repeated at the conclusion of the training block. As the students did not complete their 20 hours of instruction at exactly the same time, the posttesting was implemented in two phases, in order that students were able to complete the program and receive posttesting within a week's time.

The posttesting was performed by both of the experimenters and two of the four qualified teachers who had originally been trained for the pretest session. Approximately half of the total group took part in each of the two posttest sessions. Administration format and time allotments were similar to pretest assessment.

Post-Training Feedback From Tutors - Feedback was elicited throughout the program, by means of an ongoing dialogue between the experimenters and the tutors. In addition, a questionnaire eliciting final input, was administered at an appreciation luncheon held at the end of the program. (See Appendix 4). These questionnaires were anonymously completed.

Design and Data Analysis

The procedures developed for the proposed training study correspond to a repeated measures design, with three groups nested under the training factor (Campbell & Stanley, 1963). In addition to pre/post assessment on various reading achievement indices within each training group, data on accuracy and reading rate, based on training materials, were analyzed over the twenty hours of instruction to record learning profiles within each group.

Analysis included tests of significance for group differences across pre/post variables (reading achievement), and within group changes in reading accuracy and rate across the levels of the respective programs. For this part of the analysis there was a total of eight data points.

Limitations of the Study

There are a number of factors which may jeopardize validity of a pre/posttest research design with controls (Campbell & Stanley, 1963). Some of these factors which may impact negatively on the internal validity include representativeness of the sample, history, testing, statistical regression, biases, and experimental mortality. Other factors may jeopardize the external validity or generalizability (Campbell & Stanley, 1963). That is, it may be difficult to predict that the effects of the treatment in this study would generalize to other groups of students or settings. The reactive effects of experimental arrangements are addressed. The following discussion indicates how the design of the study attempted to control for these factors.

Representativeness of the Sample - This sample was selected from one school and represents a very small number of students within the population of grade nine students.

Data concerning educational background and occupation of family members were not available. Thus it was not possible to identify socio-economic class variability associated with reading achievement. However, the school selected is representative of vocational schools which serve students from rural, urban, and suburban districts. School officials indicated, and records confirmed, that many of the students were demonstrating long-standing reading problems. Within the school itself, the students were selected from all those students from a total of four classrooms who met the eligibility criteria.

History - This factor has been addressed by matching the subject variables in each of the two training groups and the control group. Subjects were matched on the basis of chronological age, sex, assessed intellectual capacity, subtype classification, and a history of low achievement in reading.

Testing - A period of three months elapsed, between the dates of the pretest and posttest sessions. It appears the length of this period of time precluded the effects of taking the test upon the scores of the second testing.

One of the instruments used was not supported by complete reliability and validity data. No normative data were available for the computerized portions of the

Autoskill Test Battery. The results of these portions of the Autoskill Test Battery are employed to establish criteria for subtypes. Without reliability and validity data it is difficult to substantiate the categorical differences of the subtypes.

Statistical Regression - It has been noted that low achievers appear to spontaneously improve upon a follow-up assessment. Thus one may confound the effects of treatment with this phenomenon. This factor has been addressed through the use of control groups. If regression occurs, its effects should be evident in all three groups. In addition, frequent observations were made; data was collected on a daily basis. Thus change was monitored very closely throughout the period of the study.

Biases - Care was taken to ensure lack of bias in subject selection. The 18 pupils, unknown to the experimenters, were selected from a pool of four grade nine classrooms, based upon objective criteria : age, sex, cognitive ability, subtyping, and reading achievement. Accuracy of the subtyping and matching of groups were independently verified by a second experimenter.

Experimental Mortality - Attempts were made to ensure the stability of the groups throughout the training period.

Pupils known to be chronic absentees or planning to transfer out of the school were not included in the study. In addition, daily attendance records were maintained. As the study was ongoing over a period of three months, pupils were provided with opportunities to make up sessions lost due to illness or other occasional absenteeism. However, in spite of such measures, experimental mortality did occur. Two students, one from each of the training groups, were not included in the analysis of results, as each was not able to accumulate twenty hours of instruction. One student demonstrated chronic absenteeism; the other was unexpectedly hospitalized.

Reactive Effects of Experimental Arrangements - The study took place within the normal time schedule and environment of the subjects being trained. The classroom teachers involved were aware of the training arrangements; the students perceived that the training study was part of their regular ongoing English program. It appears reasonable to assume that similar secondary vocational students, trained within their school environment, would respond similarly.

Chapter Four

Results

Reading Achievement Data

Tests for homogeneity of variance were performed on the pretest reading achievement (reading word recognition grade level, reading rate, reading comprehension) and Autoskill variables, across the three groups. There were no significant differences prior to training. Table 1 provides specific data concerning the scores on the reading achievement variables. As indicated by the Stanford Diagnostic Reading Test (SDRT), all groups demonstrated a mean reading rate falling in the bottom quartile. Grade equivalent scores as determined by the Wide Range Achievement Test (WRAT) suggested a mean reading lag of at least four years for all groups at pretest. Test of Reading Comprehension (TORC) standard scores of from 8 through 12 represent the average range; 8 of the 9 pretest mean standard scores for reading comprehension fell near the bottom of or below this range. Paragraph reading appeared to be most deficient for each of the three groups.

The data in Table 1 indicate the effect of the three training conditions on the reading achievement variables. These data suggest that two of the three treatment conditions were significantly more effective in improving

Table 1

Pre-Post Training Mean and Standard Deviation Scores for Reading Achievement Tests Across Groups

Reading	Autoskill		Repeated Reading		Control	
	Pre	Post	Pre	Post	Pre	Post
SDRT * %ile	17.8 (5.3)	47.0 (2.74)	19.2 (4.76)	42.6 (8.93)	22.17 (12.33)	27.5 (10.88)
WRAT * St. Score	63.2 (20.42)	77.8 (4.76)	68.8 (2.77)	81.4 (3.91)	70.5 (6.50)	71.83 (5.91)
G.E.	3.8 (.77)	5.3 (.76)	3.5 (.44)	5.7 (.98)	4.2 (.98)	4.3 (1.06)
TORC Para-graph	7.6 (1.14)	7.6 (2.70)	6.8 (1.79)	7.4 (2.88)	6.5 (3.02)	6.2 (2.33)
Similar-ities **	7.8 (1.30)	9.2 (1.10)	7.4 (1.14)	9.0 (3.39)	8.17 (2.04)	6.8 (2.04)
Sentence Sequence St. Score	9.6 (2.70)	10.0 (2.83)	7.0 (1.41)	9.4 (1.52)	8.67 (1.75)	8.83 (1.94)

* $p < .001$
** $p < .05$

accuracy and rate of decoding. The effects of the three training conditions on the dependent variables were analyzed in a 2 (pre/post) x 3 (treatments) repeated measures ANOVA. Post hoc comparisons (Tukey) were made when overall significance was noted.

Both computer programs were associated with significant gain in reading rate, $F(2,13) = 30.66$, $p < .001$, compared to the control group. There was no significant difference between the two computer groups. The Autoskill and Repeated Reading groups moved from the bottom quartile, almost to the 50 percentile level; the control group demonstrated little growth.

Similarly, the two groups using the computer programs were able to achieve significant gain in word recognition accuracy, compared to controls, who made no real gain, $F(2,13) = 13.06$, $p < .001$. The Autoskill and Repeated Reading groups were able to achieve significant mean gains of from one and a half to two grade levels, while the controls advanced one tenth of a grade level, in the three months that elapsed between the administration of pretest and posttest assessment batteries.

Change in performance on the reading comprehension measures was less dramatic. However, on the similarities subtest of the TORC, the computer reading groups made significant increases compared to controls $F(2,13) = 4.30$, $p < .05$. Performance of the Autoskill and Repeated

Reading groups on the paragraph and sentence sequencing subtests of the TORC demonstrated a trend toward an increase, as compared to controls. However, these gains did not reach significance.

Autoskill Data

The Oral Reading, Audio-Visual Match, and Visual Match subtests of the Autoskill Test Battery at pretest were each regrouped according to the type of decoding unit each represented. This regrouping resulted in letter, syllable, and word clusters for each strand. Students demonstrated greatest difficulty on the Oral Reading strand of clusters (See Table 2). The Audio-Visual Match proved to be somewhat less difficult for students (See Table 3), while students demonstrated greatest proficiency on the Visual Match clusters. Thus the discussion of the analysis of Autoskill data will focus on the Oral Reading and Audio-Visual Match cluster performance.

Tests indicated no significant difference between groups on the Autoskill Oral Reading variables at pretest (See Table 2). In fact, the error rate was relatively low. The highest mean rate for the letters cluster was 3.8, out of a total of 30 items. Similarly, the highest mean rates for syllables and words were 8.0 and 4.5 respectively, each out of a total of 75 items. For all groups, average

Table 2

Pre-Post Training Mean and Standard Deviation Scores for Autoskill Oral Reading Letter, Syllable, and Word Subtest Clusters Across Groups

Autoskill Oral Reading Subtests	Autoskill		Repeated Reading		Control	
Letters	Pre	Post	Pre	Post	Pre	Post
Errors	3.8 (5.75)	7.8 (4.55)	3.4 (5.41)	2.5 (2.69)	1.4 (.86)	9.8 (6.10)
Latency	1668.5 (255.2)	1065.3 (163.3)	1839.1 (1043.9)	1233.2 (331.2)	1690.1 (540.7)	1299.3 (211.9)
Syllables						
Errors	8.0 (2.48)	27.9 (11.78)	7.2 (1.68)	34.5 (12.72)	5.9 (2.08)	35.7 (17.97)
Latency	2278.3 (287.2)	1830.6 (559.2)	2412.8 (559.6)	1975.4 (402.0)	1815.5 (440.12)	1535.2 (242.3)
Words						
Errors	3.9 (4.31)	8.04 (4.39)	4.5 (4.98)	8.5 (4.21)	2.7 (2.97)	12.2 (10.35)
Latency	1227.6 (119.2)	1150.8 (180.8)	1409.6 (136.7)	1293.7 (206.5)	1171.5 (176.6)	1085.1 (135.6)

Table 3

Pre-Post Training Mean and Standard Deviation Scores for Autoskill Audio-Visual Match Letter, Syllable, and Word Subtest Clusters Across Groups

	Autoskill		Repeated Reading		Control	
<u>Letters</u>	Pre	Post	Pre	Post	Pre	Post
Errors	2.3 (1.04)	12.1 (10.89)	3.7 (2.14)	11.6 (8.99)	2.7 (1.03)	27.4 (14.49)
Latency	1442.5 (399.7)	972.7 (148.1)	1480.8 (586.6)	1124.1 (191.3)	1348.3 (429.5)	1045.3 (264.3)
<u>Syllables</u>						
Errors	4.9 (1.45)	15.1 (10.06)	4.8 (1.39)	28.2 (11.84)	4.3 (.35)	28.3 (16.49)
Latency	1919.2 (355.6)	1607.3 (325.4)	1850.0 (368.5)	1817.4 (487.9)	1988.8 (378.7)	1632.5 (358.7)
<u>Words</u>						
Errors	2.8 (.54)	7.5 (7.07)	3.1 (.99)	14.0 (5.58)	2.6 (1.04)	19.7 (19.06)
Latency	1487.9 (271.3)	1335.4 (237.6)	1561.6 (96.3)	1478.6 (157.1)	1548.7 (127.9)	1378.7 (155.4)

latency was greatest for nonsense syllables, followed by letters and words.

Effects of training on the Autoskill Test Battery Oral Reading subtest performance were analyzed for difference scores by means of an analysis of variance across groups. Pre/post difference mean and standard deviation scores for error rates and average response latency, are listed in Tables 4 and 5 respectively. Again, the subtests were clustered. All three groups demonstrated decreases in decoding speed; there was no significant difference in the performance of any of the groups. There were uniform decreases in latency across each of the three types of decoding units. Again, syllables required more decoding time for each of the three groups, while there was some minor variation in whether letters or words proved more time-consuming for each of the three groups. Latency scores for words demonstrated the smallest relative decreases in response time. Accompanying these decreased latency scores however, were increased error rates. These error rate patterns varied across decoding types; the error rate on nonsense syllables was markedly higher, as compared to letters and words. Mean error scores indicate that students in all groups may have erred on as many as half of the 70 items presented in the syllables clusters. The error rate on words, while demonstrating an increase, appears less severe, as the computer groups had a mean

Table 4

Mean and Standard Deviation Scores for Pre-Post Error Difference Scores on Autoskill Oral Reading and Audio-Visual Match Strands Across Groups

Subtest Cluster	Group	Autoskill Strands: Oral Reading	Audio-Visual Match
Letters	Autoskill	4.0 (6.39)	9.8 (11.30)
	Repeated Reading	-0.9 (7.18)	7.9 (10.29)
	Control	8.3 (6.42)	24.8 (15.13)
Syllables	Autoskill	19.9 (10.83)	10.2 (10.07)
	Repeated Reading	27.2 (10.95)	23.4 (11.26)
	Control	29.7 (15.98)	24.0 (16.36)
Words	Autoskill	4.2 (7.38)	4.7 (6.79)
	Repeated Reading	4.0 (7.21)	10.9 (5.06)
	Control	9.5 (9.75)	17.1 (19.05)

Table 5

Mean and Standard Deviation Scores for Pre-Post Latency Difference Scores on Autoskill Oral Reading and Audio-Visual Strands Across Groups

		Autoskill Strands	
Subtest Cluster	Group	Oral Reading	Audio-Visual Match
Letters	Autoskill	-603.2 (351.9)	-469.8 (267.9)
	Repeated Reading	-605.9(1099.5)	-356.7 (550.0)
	Control	-390.8 (462.7)	-303.0 (395.4)
Syllables	Autoskill	-447.7 (351.3)	-311.9 (622.7)
	Repeated Reading	-438.5 (402.3)	-32.6 (522.4)
	Control	-280.3 (319.1)	-356.3 (463.5)
Words	Autoskill	-76.8 (113.9)	-152.6 (448.8)
	Repeated Reading	-115.9 (134.6)	-82.9 (238.3)
	Control	-86.4 (237.6)	-170.0 (150.6)

increase of approximately four errors out of the 75 items presented in each subtest cluster, while the control group demonstrated an increase of approximately ten errors.

A similar analysis was made for the Audio-Visual Match strand. Pretest and posttest scores for these clusters are presented in Table 3. Again, no significant differences were noted between groups at pretest. Audio-Visual Match scores at posttest also indicated a general increase in error rate accompanied by a decrease in latency. There was a uniform trend for latency decrease across the clusters. Again, syllables required the longest response time. As on the Oral Reading clusters, the error rate on syllables demonstrated the highest posttest rate.

Pre/post difference mean and standard deviation scores for error rates and average response latency are listed in Tables 4 and 5. An ANOVA on cluster differences, by group and type, indicated no significant differences in effects of training on the three groups, with respect to the Audio-Visual Match subtest clusters.

It should be noted that while the subjects in this study demonstrated increases in error rates as noted, pretest error rate levels for letters, syllables, and words indicated a higher level of accuracy in comparison with the subjects of the Fiedorowicz and Trites study (1987)(See Appendix 11). Also, all 13 subtests in the Fiedorowicz and Trites study were grouped in one cluster, making it impossible to compare gains or losses in the three clusters.

Autoskill Subtypes

All students taking part in the study had been subtyped, based upon a pre-established profile analysis provided by Fiedorowicz and Trites (1985) as part of the Autoskill computer program. The students were classified as either Type O (Oral) or Type A (Audio-Visual Match); no students were classified as Type S (Visual Match). In the present study, no significant differences between subtypes were noted on reading achievement measures at pretest (See Table 6). Performance of the subtypes on Autoskill clusters was also examined. There were no significant differences noted at pretest by type, on the Oral Reading clusters (See Table 7). However, trends toward significant difference were noted in pretest syllable cluster error rate, $F(1,14)= 3.64$, $p = .08$, and word cluster error rate, $F,(1,14) = 4.14$, $p = .06$. Nevertheless, analyses of variance by Group (3) and Type (2) on pre-post training difference scores for reading achievement and Autoskill subtest clusters yielded no significant differences for subtype classification. Similar analyses were performed on the Audio-Visual clusters. No significant differences were found in these

Table 6

Mean and Standard Deviation Scores of Reading Achievement Tests by Autoskill Subtype at Pretest

Reading Test	Type O (Oral) (N = 10)	Type A (Audio-Visual Match) (N = 6)
SDRT Reading Rate %ile	19.4 (10.50)	20.7 (2.07)
WRAT Standard Score	65.7 (14.43)	71.0 (4.15)
Grade Equiv.	3.8 (.83)	3.9 (.76)
TORC Paragraphs Standard Score	6.4 (2.41)	7.8 (1.17)
TORC Similarities Standard Score	7.6 (1.58)	8.2 (1.47)
TORC Sentence Sequencing Standard Score	8.2 (2.39)	8.8 (1.83)

Table 7

Mean and Standard Deviation Scores of Autoskill Subtype Cluster Error Rate and Latency at Pretest

Autoskill Oral Reading Clusters	Type O (Oral) (N = 10)	Type A (Audio-Visual Match) (N = 6)
<u>Letters</u>		
Errors	3.8 (5.15)	1.08 (.97)
Latency	1824.6 (784.4)	1572.2 (280.1)
<u>Syllables</u>		
Errors	7.72 (2.30)	5.73 (1.38)
Latency	2121.3 (549.2)	2190.0 (429.4)
<u>Words</u>		
Errors	5.0 (4.38)	1.3 (.71)
Latency	1287.4 (184.8)	1223.4 (160.5)

analyses.

Part of the investigation into the role of subtyping in appropriate remedial programming had included a switch of two students, in that a Type O and Type A were trained in the Audio-Visual Match and Oral Reading strands, respectively. A T-Test was performed, comparing the achievement of each switched student on the subtest cluster difference scores, with two students who had received training as recommended by the Autoskill subtyping guidelines. No significant differences were noted between the Type O students trained on the Oral Reading strand, and the Type O student trained on the Auditory-Visual Match strand. There was a significance difference noted however, between the difference scores of the Type A students trained in the Auditory-Visual Match strand, and the Type A student trained in the Oral Reading strand. This difference was noted for word errors, $T(df=1) = 16.36$, $p < 0.05$. It is interesting to note however, that the two Type Audio-Visual students trained on the Audio-Visual program achieved a mean error rate of 4.65 (S.D. = 0.2), while the Type Audio-Visual student trained in the opposite, or Oral Reading program achieved a mean error rate of 0.4. At any rate, as the only significant difference on the cluster achievement differences involved the cluster word error rate, and since a trend toward significance had also been noted on the results of the analysis of pretest differences by subtype, these two switched students were included in their original subtype group on all other analyses.

Autoskill Training

The twenty hours of training were accumulated during 40 sessions, over a three month period. Each subject's 40 sessions were regrouped into eight blocks of five sessions, in order that analyses over the training period could be made, on a week-by-week basis. A oneway ANOVA of Autoskill training performance, including number of subtests and blocks completed, difference scores on the Autoskill subtest cluster error and latency scores, as well as reading rate and word recognition achievement, indicated no significant difference by subtype. Thus all data is presented for the Autoskill group as a whole. Tables 8 and 9 include data with respect to performance on the training program. It was felt that pupils would not be inclined to react positively to the program, if the criterion for three consecutive blocks were maintained for letters, and grades 1 through 4 words. Thus, if pupils were able to demonstrate the accuracy and latency criteria on the first block of these subtests, they were allowed to go on to the next subtest without being required to achieve that criteria on three consecutive blocks.

Table 8

Mean and Standard Deviation Scores for Autoskill Group (N =5) On Number of Blocks Required For Subtests 1 through 21

Subtest Number	Number of Blocks	Subtest Number	Number of Blocks
1	1.4 (.89)	14 (Gr.1)	2.4 (.89)
2	2.0 (1.73)	15 (Gr.2)	2.2 (1.09)
3	16.0 (6.60)	16 (Gr.3)	3.8 (2.28)
4	6.8 (1.92)	17 (Gr.4)	4.4 (2.08)
5	10.3 (7.85)	18 (Gr.5)	4.4 (1.34)
6	9.6 (3.58)	19 (Gr.6)	6.2 (2.86)
7	10.2 (8.98)	20 (Gr.7)	7.8 (2.59)
8	7.6 (2.97)	21 (Gr.8)	10.6 (10.41)
9	6.6 (3.71)		
10	13.0 (9.11)		
11	5.6 (2.41)		
12	5.4 (2.88)		
13	6.6 (4.51)		

Legend

Subtest Number	Subtest Content
1	Letter Names
2	Letter Sounds
3	cv-vc Syllables
4	cvc Syllables
5	cvc Words
6	cvvc Syllables
7	cvvc Words
8	cvcv Syllables
9	cvcv Words
10	ccvc Syllables
11	ccvc Words
12	cvcc Syllables
13	cvcc Words
14 through 21	Graded Word Lists

Table 9

Mean and Standard Deviation Scores for Autoskill Group (N = 5) On Completion of Subtests Across Eight Weeks of Training

Week	Subtest Number Completed	Number of Blocks Completed
1	4.1 (1.8)	24.2 (7.7)
2	7.4 (2.7)	30.2 (7.4)
3	12.9 (4.7)	27.4 (3.4)
4	18.7 (8.9)	26.2 (5.3)
5	23.7 (11.2)	26.8 (2.6)
6	30.3 (11.9)	66.6 (66.1)
7	33.1 (10.9)	66.8 (56.3)
8	35.9 (10.4)	80.2 (48.6)
Total	35.9 (10.4)	348. (141.4)

<u>Legend</u>

Subtest Number	Subtest Content
1,2	Letters
3 through 13	Syllables and Words (one syllable, ungraded)
14 through 21	Graded Words (Grades 1 through 8)
22 through 29	Graded Phrases (Grades 1 through 8)
30 through 37	Graded Sentences (Grades 1 through 8)
38 through 46	Graded Paragraphs (Grades 1 through 9)

Students required fewest blocks to achieve criterion on letters (See Table 8). Several letter sequences provided particular difficulty (cv-vc syllables, cvc words, cvvc syllables and words, and ccvc syllables). There was a wide range of variability in the number of blocks required by students to achieve criterion on most of these particular subtests. While for the most part the blocks required to achieve criterion decreased as the students moved through subtest 3 through 13, there was a trend toward more blocks required per subtest, as the students moved through the graded word lists. There was less variability in the number of blocks required to complete these subtests. This analysis could be performed only on the first twenty-one subtests, as this was the highest level of subtest completed by all pupils.

Students required on average three weeks to complete the first 13 subtests of letters, and one syllable nonsense syllables and words (See Table 9). The eight graded word lists required on average approximately two weeks to complete. However, the number of blocks increased dramatically at the eighth grade level (See Table 8). While some pupils were only able to move through to the end of the graded word lists, several were able to advance as far as paragraphs. Variability in the subtest number completed each week increased, as the weeks of training progressed (See Table 9). As students moved into paragraphs, from the sixth week on, the number of blocks completed each week increased dramatically. This was due partly to the fact that paragraph blocks require considerably less time to complete; only three trials (three readings of a paragraph) are required per block, as compared to 50 trials per block on all previous subtests.

Table 10 lists the error and latency difference scores for the subtest clusters, thus indicating the change in pupil performance from the first to the last block of each subtest. Syllables experienced the greatest gain in accuracy and latency, indicating these to be the most deficient cluster for pupils. Words experienced the smallest growth, indicating possibly a higher initial score with respect to error rate and latency.

A breakdown by student identification number, on variables such as number of subtests and blocks completed, difference scores for error rate and latency, as well as difference scores for pre-post reading rate and word recognition performance, suggested no consistent pattern involving any correlation between these variables.

Autoskill Training Profiles

It is of interest to present individual profiles of a Type O and Type A student (See Table 11). Each pupil was able to make considerable gains on both reading rate and

Table 10

Mean and Standard Deviation Pre Post Block Scores for Autoskill Group (N=5) (Subtests 1-13)

Subtest Cluster	Difference Between First and Last Block of Subtest Cluster
Errors	
Letter	6.0 (4.0)
Syllable	7.8 (3.0)
Word	2.8 (1.9)
Latency	
Letter	5.0 (97.5)
Syllable	382.0 (184.6)
Word	.5 (99.5)

Table 11

Autoskill Training Profiles

Subtype	Type A	Type O
Number of Subtests Completed	29.0	21.0
Number of Blocks Completed	232.0	226.0
	Difference Scores	
Errors		
Letters	10.0	8.0
Syllables	12.0	9.6
Words	4.8	3.2
Latency		
Letters	0.0	0.0
Syllables	250.0	285.0
Words	-60.0	-65.0
Reading Rate		
Pretest	18	22
Posttest	49	44
Difference	31	22
Word Recognition		
Pretest	69	75
Posttest	77	80
Difference	8	5

Legend

Subtest Number	Subtest Content
1 through 13	Letters, Syllables, and Ungraded Words
14 through 21	Graded Word Lists, Grades 1 through 8
22 through 29	Graded Phrase Lists, Grades 1 through 8

word recognition measures, with the Type A student demonstrating somewhat of a greater gain. Although approximately the same number of blocks were completed by each student, the Type A was able to complete the eight graded phrase lists, while the Type O was able to complete only the eight graded word lists. It is notable that the Type A student's word recognition and rate difference scores were slightly higher. Difference scores for the Autoskill subtest cluster errors were slightly higher for the Type A student, indicating that this student's base error rate was likely higher. Latency gains or losses were similar, with each student slowing his/her response time in order to achieve accuracy criterion on the word subtests. Syllables demonstrated slightly higher error and latency scores for both students, suggesting a higher level of difficulty on this cluster. This had already been suggested by analyses of group performance on the Autoskill pre-post training data.

Repeated Reading Training

The twenty hours of instruction were regrouped into eight blocks of five sessions each, as were the Autoskill training sessions. Group data suggest significant variability between students over the eight weeks of the program, with respect to total stories read, number of repeats required, and initial rate of reading (See Tables 12 and 13). However, some patterns did emerge through the training period.

Students read, on average, 11 passages each week, while engaging in an average of 10 repeat reads weekly. Early in the program, when students were working with passages of grade two through grade four reading level, students read more passages, presumably because the material was easier (See Chapter 3 for grade levels of passages). In fact, if students were able to meet the criterion of 100 wpm on the initial readings of the first three stories of a grade level set, they were advanced to the next set without being required to read on at that grade level. The mean initial reading rates of the stories read during these first two weeks especially, indicates rates close to criterion (See Table 13). Thus it was possible in the early weeks of the program, for the students to move through one or two grade levels within one week. As the material became more difficult however, in the third through fifth weeks, the number of stories read each week decreased; students demonstrated a decrease in reading rate. Table 12 indicates this took place with passages at an approximate early fourth grade level. This confirms data presented in Table 1, which indicated that students in the three groups had mean reading levels ranging from mid-third through early-fourth grade reading

Table 12

Mean and Standard Deviation Scores for Repeated Reading Group (N = 5) On Reading Variables Across Eight Weeks of Training

Weeks	Total Stories Read	Total Number of Repeats	Total Number of Stories Repeated	Story Number At End Of Week
1	14.4 (3.21)	10.2 (7.86)	7.2 (5.4)	24 (7.26)
2	14.0 (3.61)	10.4 (7.60)	6.6 (2.41)	44 (13.07)
3	10.0 (3.67)	8.8 (3.63)	6.8 (1.64)	54 (14.16)
4	9.0 (1.58)	11.6 (1.95)	7.8 (1.30)	62 (13.13)
5	11.2 (2.78)	13.4 (5.51)	7.8 (0.45)	73 (14.61)
6	10.8 (1.64)	7.0 (4.53)	5.4 (2.79)	80 (16.04)
7	10.2 (2.49)	8.8 (3.11)	6.6 (2.70)	95 (17.58)
8	11.2 (4.03)	9.2 (5.22)	6.4 (3.78)	105 (20.7)

Table 13

Mean and Standard Deviation Rate and Error Scores for Repeated Reading Group (N = 5) Performance Across Eight Weeks of Training

	Beginning-Week Reading		Mid-Week Reading		End-Week Reading	
Week	Rate	Errors	Rate	Errors	Rate	Errors
1	91.8 (11.05)	4.8 (2.28)	95.2 (21.19)	3.0 (.71)	91.8 (17.25)	4.6 (2.3)
2	92.8 (15.90)	1.4 (1.34)	91.6 (12.18)	2.2 (1.64)	88.8 (9.47)	5.2 (7.23)
3	88.6 (11.28)	4.0 (1.58)	89.6 (8.08)	4.2 (3.77)	88.2 (17.34)	3.6 (2.61)
4	83.0 (7.31)	3.2 (1.92)	88.0 (10.75)	2.6 (2.19)	89.4 (3.91)	2.8 (3.03)
5	93.2 (10.50)	2.2 (1.64)	89.4 (7.70)	2.4 (2.30)	87.4 (7.99)	3.0 (1.23)
6	97.0 (13.45)	2.8 (2.05)	95.0 (17.39)	3.2 (2.39)	95.6 (12.28)	1.6 (1.34)
7	107.6 (16.88)	1.4 (1.14)	87.2 (9.68)	4.8 (2.05)	85.0 (19.55)	6.0 (3.94)
8	87.4 (17.18)	3.0 (2.83)	101.8 (16.3)	3.2 (1.92)	99.2 (30.29)	1.4 (1.67)

levels, at the time of pretest.

In order to assess significant changes in rate over weekly periods, multiple analyses of variance (MANOVA) were conducted on reading rate for beginning, mid-, and end week periods, over two weeks. While no overall significant levels were achieved, some trends were noted. The lower initial reading rates commencing at fourth grade level were maintained until passages at a grade 5 - 6 reading level were being practiced. During the sixth week, as pupils became more fluent with this level of material, rates seemed to indicate a trend toward increase. Another decrease of reading rate was experienced during the seventh week, as more students were encountering the sixth grade level passages. Then by the last week of the program, when all students were well into sixth grade material, rates appeared to demonstrate another trend toward increase. No significant changes, positive or negative, were noted with respect to error rates.

Very little gain was observed on the comprehension questions that were part of the repeated reading training. The tutors recorded the students' responses; these responses were monitored by the experimenters. Students achieved a high level of comprehension early in the program, at the time when each began passages at the second grade level. This high ceiling, reached at the outset of the program, was maintained.

Repeated Reading Profiles

The different fluency styles of two students who entered the program with equivalent pretraining achievement scores are presented in Table 14. Training data suggest that Student A was a more fluent reader during the training period. Student A read almost twice as many passages as Student B, reading more stories each week, and completing the program reading passages at a sixth grade level. While his peer was beginning to work with sixth grade material at the close of the program, he did not have the opportunity to gain much experience at this level. Student A demonstrated a considerably higher rate at first reading, which was already close to criterion, and repeated considerably fewer stories than his peer. The fact that each student was required to repeat almost the same number of stories indicates that Student B was required to perform more repeats for each story, prior to attaining a criterion reading rate. There was no consistent pattern with respect to error rate. Student B, the reader required to make the greatest number of repeats, demonstrated a greater difference score from pretest to posttest, on measures of reading rate and word recognition, although scores at pretest were roughly equivalent.

Table 14

Repeated Reading Training Profiles

	Student A	Student B
Total Stories Read	102	64
Mean Number of Stories Per Week	12.75	8.0
Last Story Number Read	122	69
Total Number of Repeats	84	129
Total Number of Stories Repeated	66	59

<u>Training Rate and Error Score</u>

	Mean Rate	Mean Errors	Mean Rate	Mean Errors
Beginning of Week	90.12	3.1	75.37	3.5
Mid-Week	92.75	4.62	80.87	2.0
End of Week	92.75	4.75	70.25	5.87
Week Mean	91.87	4.16	73.83	3.79

<u>Pre-Post Reading Achievement</u>

	Student A	Student B
Reading Rate (%ile)		
Pretest	15	22
Posttest	30	44
Difference	15	22
Word Recognition (Standard Score)		
Pretest	69	66
Posttest	79	88
Difference	10	22

Chapter Five

Discussion

The purpose of this study was to compare two computerized remedial reading programs, in order to evaluate their effectiveness in improving the decoding and comprehension skills of adolescents with significant and long-standing reading difficulties. Also of interest was the extent to which subtyping of the unskilled reader was a prerequisite to effective remedial programming. In addition, the study sought to explore the role to be played by tutors in delivering the computerized remedial programs. In retrospect, it is clear that the study was somewhat over-ambitious, with respect to the objectives of the study, and the small sample size. The loss of one subject in each of the two treatment groups aggravated this problem. In light of these limits, this study is best considered a pilot study. Thus the results must be interpreted with caution, and be considered suggestive, with implications for additional research.

Cautions Against The "Either-Or" Philosophy

Each program is alike in that it is based upon the automaticity (Samuels, 1979) and verbal efficiency (Perfetti, 1985) theories. At the same time, the two programs demonstrate significant differences, and can be seen to represent extreme points of view. On the one hand, the repeated reading program represents a holistic approach to the treatment of reading difficulties, and reflects the interactive approach to decoding. The Autoskill program on the other hand, is a componential approach requiring subtyping of the student, and programming accordingly to the student's identified weaknesses. It reflects a bottom-up view of decoding.

A number of decades ago, Dewey (1938) cautioned the educational milieu against its tendency to subscribe to an "Either-Or" philosophy, in terms of educational trends. Chall (1989) has decried what she identifies as a current trend to reject the teaching of phonics, essentially a bottom-up view. Otto and Smith (1983) call for caution, and a combination of skill-centered and meaning-centered approaches to the teaching of reading. This study appears to respond to some of these concerns, in that it has demonstrated that each of the two programs has value, in that there were no differential effects of the two treatment conditions on the dependent variables measured. Each of the two programs was able to effect significant improvement in word recognition and reading rate. Each program apparently was able to provide the repetition identified as necessary for struggling readers (Hargis, Terhaar-Yonkers, Williams, & Reed, 1988).

Decoding and Comprehension

It is interesting to note that Fiedorowicz and Trites (1987) had identified a time period of approximately 21 hours as being required to effect significant improvement in decoding skills, but that 56 hours were required before significant comprehension gains were noted. The present study planned for 20 hours of instruction over a three month period. Indeed, decoding improvement was noted, while for the most part, only a trend toward comprehension gain was evident. Comprehension gains in both training groups were modest and not significantly different from each other, and with the exception of the similarities subtest of the TORC, not significantly different from the control group. A similar study, taking place over a longer period of time, may indicate whether, as Samuels (1979) and Perfetti (1985) had suggested, a clear or causal relationship between decoding and comprehension gains can be supported. Such a long-term study may also clarify whether either of the programs may be superior, when implemented over a longer period of time. If, as Perfetti (1985) suggests, a high quality word representation is basic to automatic word recognition, one might hypothesize that the repeated reading technique, performed in context, might be superior to the Autoskill technique of developing decoding skills in isolation. If improved decoding skills precede any improvement in comprehension, as is suggested by the results of the present study, one cannot preclude differential effects of the two treatment conditions on the comprehension variables, given a longer period of time.

Another factor which may have impacted on the modest comprehension gains may be the comprehension measure chosen for this study. The TORC was chosen in order to allow students the maximum opportunity to demonstrate their comprehension abilities, as it is an untimed test. In retrospect, it may have been useful to also include a standardized timed measure. The focus of the study was to develop the subjects′ fluency, and hence their comprehension achievement. It may therefore have been of interest to note any correlation between the subjects performances on the timed and untimed measures. Thus it may have been possible to determine whether a timed comprehension measure, administered at pre- and posttest, may have been more sensitive to changes in comprehension achievement resulting from speeded word identification processes.

Programming for the "Real World"

The classroom practitioner is concerned always with whether a technique implemented and proven useful in other situations, will indeed bear fruit in his/her own particular setting. The "real world" of the secondary vocational school includes students whose long history of reading difficulty has contributed to the building of a wall of apathy and negative attitudes to reading. Experience has demonstrated to teachers that this wall is difficult to penetrate. Another factor further compounds the problem. In the vocational school setting, students have been streamed and are theoretically similar with respect to academic achievement levels. However, the present study's selection process indicated a wide range of reading ability, from early third grade through to the eighth grade level, grouped in the same grade 9 english class. Meeting the needs of such a diverse population, who may demonstrate as well inadequate motivation, is a difficult but real task.

The present study indicates that the programs evaluated, as well as the techniques employed in their implementation, may prove to be useful and practical for the "real world". Each of the two treatment groups achieved significant academic gains. For the most part, students were able to maintain interest and motivation over the three month period during which the study took place. Informal observations indicated a high level of time on task, and considerable student-tutor interaction involving the content of the program. While in this case two adults were available to provide training and supervision of the program, these tasks might have been implemented by one teacher, providing adequate training and initial resource assistance were provided.

Components of a Viable Remedial Program

Several components of the program were especially valuable in making the program one that was feasible and practical. The first involves the use of cross-age tutoring. The adoption of peer tutoring arises from a real need, in that the school could not have provided teachers to act as tutors to each of these 12 students, on a regular basis.

Informal observation indicated the tutoring partnership profited from the age difference of student and tutor. A sense of respect on the part of the students, for their older peer models, was evident; this served to form the foundation of the tutoring partnership. The experience also appeared to build a sense of continuity and school community for the students, as indicated by the students' interests in the grade 12 students' courses and other school activities.

Students expressed preferences for specific tutors, and vice-versa. To some degree this may have been due to personal characteristics and social factors, but informal observation suggested as well that some tutors fell more naturally into their roles, and were preferred by the students for the manner in which they conducted the tutoring exercise.

The questionnaires completed by the tutors at the close of the program are useful in revealing tutor perceptions of the tutoring role. This, combined with anecdotal comments made by the grade 12 teacher, informal observations of the experimenters, and ongoing feedback from tutors and students throughout the program, provide information relevant to the practitioner interested in initiating a tutoring experience.

The tutors identified a number of tutor characteristics that were important to the tutoring partnership. Patience was the characteristic identified most frequently. In addition, the grade 12 students suggested that a tutor must be courteous and pleasant, be a good listener, be understanding, provide encouragement, and maintain attention on the task at hand. Tutors must have the prerequisite skills to deal with the specific program being used, but yet be prepared to ask for assistance from the teacher when necessary.

As well, the tutors identified difficulties in their roles. The study varied the student with whom the tutor was working. A number of tutors indicated these changes presented difficulties. They indicated this made the beginning of the session awkward, as tutor and student became re-acquainted with each other, and the student's progress to date. Many tutors found it difficult to maintain an even and positive demeanour during the tutoring exercise. They indicated particular difficulties with continuously having to demonstrate an interest in the task, appear pleasant, and maintain patience, even "when they make the same mistake over and over". Many tutors identified factors which may have precipitated difficulties in their own academic careers. They indicated that it was often difficult to focus in on one's own student, against the competition of background noise. They had difficulty listening and writing at the same time, when recording comprehension responses. And, in spite of the fact that these were grade 12 students, several indicated a difficulty reading some of the vocabulary. The experimenters often observed students and tutors working together to identify a particular word, and asking the teacher for assistance when necessary. This intensive interaction with each other and with curriculum materials was a positive outcome of the tutoring partnership, as had been indicated already by Slavin (1983). Indeed, tutors indicated they were adding words to their speaking and reading vocabularies. This confirms that the use of the tutors appears to benefit both tutor and tutee, as has been suggested in the literature (Cohen, Kulik, & Kulik, 1982; Osguthorpe and Scruggs, 1986).

A second component that made this project a viable one, and which may be essential to any similar undertaking, was the flexibility of school administration and teachers involved. Any project which requires cooperative planning and use of facilities, and ongoing communication between a number of individuals, requires flexibility on the part of its participants. School administration was not reluctant to meet challenges; teachers responded generously with their time and input.

Provision of adequate resources appears to be another factor basic to the success of the program. In this study, many of these resources were provided by the experimenters. A great deal of preparation in terms of developing familiarity with the two programs, and preparing teaching strategies and record-keeping devices, were undertaken by the experimenters and then shared with the grade 12 teacher and the tutors. A teacher planning to undertake a computerized remedial reading program will require school and/or board resources, in terms of expertise, time, and materials.

The incorporation of computer technology as an instructional technique proved to be beneficial. The computer was able to provide individualization of program, unlimited repetition and drill as necessary, individualized and instant feedback, and perform what would otherwise be overwhelming record-keeping. Students appeared to look forward to regular opportunities to use an instructional aid that was for many of them, new and unique. Not only did they appear motivated by the use of the computer, informal observations indicated a high level of time on task throughout the program.

Autoskill Component Reading Subskills Program

There were both demonstrated strengths and weaknesses for each of the two programs. The Autoskill program was perceived by students, tutors, and the teacher, to be well organized and easily used. The ongoing feedback in the form of instant reinforcement, as well as graphs and detailed information indicating the pupils's progress after each block, provided motivation, and the incentive to improve. However, contrary to the findings of Fiedorowicz and Trites (1987), the students were not inclined to take print-outs of graphed results home. This may be a function of the adolescent personality. Although the program required extensive initial training, especially with respect to the pronunciation of the nonsense syllables, most tutors required very little guidance once the study was underway.

Several concerns are of interest. While these students were working at a reading grade level for which the program was designed, some of the content of the sentence and paragraph selections was juvenile, relative to the age and social interests of the students. The problem of obtaining high-interest/low vocabulary reading sources is of course a perennial problem for remedial educators, but one that must be considered nevertheless. The synthetic speech quality also posed a problem. While Fiedorowicz and Trites (1987) indicated that this problem had been rectified, in fact students working in the Audio-Visual strand indicated difficulty understanding the speech at times, especially with respect to the isolated letter names and sounds. Thus there is some question whether unskilled readers, who may be hampered by auditory perception problems, may meet additional hurdles unless the synthetic speech is of high quality. This is of course especially significant in the case of the Autoskill program, in which the speech segments are decontextualized, and the student is unable to employ context as an aid to word recognition.

Throughout the program, the syllables cluster always presented the highest level of difficulty for the students. However, the increase of errors on the Autoskill cluster posttest, particularly with respect to syllables, was unexpected. The only hypothesis that can be offered is that the students appeared more relaxed and confident at posttest than at pretest, and may not have been taken these subtests as seriously. Further research may indicate whether another sample from this population of unskilled readers may fare similarly.

Perhaps the greatest concern is with respect to the subtyping. The question of subtype labelling was problematic from the practitioner's perspective, as the Autoskill criteria for subtyping were subjective, and required a great deal of interpretation. Indeed, the four independent judges of the Fiedorowicz and Trites (1987) study were unable to come to agreement on a number of the cases. One may then question the feasibility of requiring the classroom teacher, who likely does not have a theoretical background in the subtype literature, to attempt this exercise. And even if he/she feels capable in making these decisions, there may be a problem in that the time required for individualized pretesting and subtyping is unavailable. Or, one may question whether this exercise is warranted at all. The current study found that the students who received programming according to the recommended subtype identification did not fare any better than those who did not. It is suggested that this aspect of the program be considered with caution.

Read It Again, Sam

The computerized repeated reading program, Read It Again, Sam (RIAS) proved to be equally effective in terms of changes in decoding or comprehension performance. The program offered similar advantages to Autoskill, in terms of individualized programming, unlimited repetition and drill, instant feedback of results, as well as record-keeping. The program was however, more demanding of the tutors. Generally the student was able to sit closer to the screen than the tutor; tutors reported it was difficult to monitor the errors as students read from the screen. Some indicated they would prefer to see fewer words on the screen, or larger print. This concern is one that may need to be addressed in the preparation of programs such as RIAS. As well, some tutors found it difficult to perform the teaching duties required, with respect to teaching new vocabulary or discussing and recording the comprehension questions. While the pre-training demands of this program were less than that of Autoskill, the concerns noted above necessitated additional monitoring of the ongoing reading activities by the teacher. These concerns may beg additional or changed emphases in the tutor training period prior to the beginning of such a program.

While some tutors and students found the stories interesting, others indicated that some were "boring". As was indicated with respect to the Autoskill program, selection of appropriate reading material must consider more than the recommended reading level, but also the interests of the students. Fortunately, the RIAS program allows for the entry of the stories of the students' choice. In fact, pupil-written stories may be typed in, by the students themselves, if that appears to be a useful exercise.

Tutor questionnaires indicated that some students and tutors reported difficulty concentrating, in the presence of many students reading simultaneously. This concern was alleviated to some degree by the provision of earphones. However, this was not always an acceptable remedy, due to the high level of self-consciousness of some of the students. This concern has implications for the planning of computer work areas, in terms of providing space, privacy, and some attempt to soundproof one station from another. Perhaps the greatest concern with respect to the RIAS program was totally unexpected, yet logical. Other researchers, working with primary and junior division children (Rashotte & Torgesen, 1985) or various age and ability groups (Samuels,1979) report that children derive a great deal of pleasure and self-confidence with the repeated reading method. The research evidence involving intermediate level students (Herman, 1985) or high school students (Carver & Hoffman, 1981) did not discuss this issue. The subjects of this study were for the most part disappointed when they had to reread a selection; achieving criterion at first reading was a source of pride. Students preferred to read many stories once, rather than to repeat a smaller number of stories. To most of these adolescents accustomed to reading failure, rereading a selection was an indication of failure, and possibly a reminder of past admonitions by teachers to "read it again" when they demonstrated difficulty with the text. One of the tutors reflected that "I see what you're trying to do, but you have to consider the feeling of the students". Nevertheless, the RIAS student profiles indicated that the student making the most repeats, relative to number of stories actually read, made greater gains with respect to word recognition level and reading rate at posttest. A teacher undertaking a repeated reading program with adolescent unskilled readers will have to consider such affective variables, and make adjustments accordingly, based on the personalities and needs of his/her students.

The extent to which the tutors were instrumental in facilitating the gains demonstrated by the subjects is open to question. Research has indicated tutors were more effective than were regular large group or small group instruction (Delquadri et al., 1986) or than paraprofessionals (Armstrong et al., 1979, cited in Jenkins & Jenkins, 1985). Fiedorowicz and Trites (1987) were able to achieve significant gains with the assistance of teachers and graduate students as tutors. It may be worthwhile to plan additional research comparing the progress of students working on an individual basis with peer tutors, to those working with trained teachers. Informal observation by the experimenters suggested that the grade 12 tutors, as might be expected, do not possess the teaching skills or reading ability expected of a trained adult teacher. On the other hand, one can not determine either to what degree the positive outcomes of peer interaction may outweigh the benefits to be accrued by employing a trained teacher as a tutor. At any rate, this may be a moot point, for as pointed out earlier, increasing economic pressure on school boards is unlikely to result in the increased allocation of teaching staff for individual tutoring.

Research of Computer Software

The chief focus of this study was on the underlying theory of the two computer programs. Reference to recent literature on school use of computer technology suggests such research is of great value. Concern exists that the appeal of the computer as an instructional tool must be balanced by methodically sound research studies which probe the efficacy of programs delivered over a significant period of time (Torgesen, 1986, Rude, 1986). However, commercial software rarely supports basic research or field-testing prior to marketing (Balajthy, 1987). A caution has been expressed that the software programs will only be as good as the principles of instruction upon which they are based (Ellis & Sabornie; 1986, Torgesen, 1986), or the teachers who use them (Cosden, Gerber, Semmel, Goldman, & Semmel, 1987), and that the teacher must ultimately be the final judge with respect to the selection and use of software (Balajthy, 1986).

Indeed there exists evidence that some current practices may not be ideal. An American survey (Mokros & Russell, 1986) indicates that teachers received little training on the use of computer technology with students demonstrating special needs. Only 11% of administrators surveyed reported offering workshops for Special Education teachers. Most often software was selected on the basis of advice from friends, resulting in ill-informed purchases. Many teachers reported a lack of time with which to become familiar with software. It appears that computer technology has already, and will continue to place increasing demands on teachers, and that more inservice action is required (Steier, 1987), especially as it has been recommended that the teacher should make the final evaluative decision with respect to the suitability of software (Balajthy, 1986).

A common thread running throughout most of the literature is best illustrated by Clark (1983) who states "The current evidence is that media are mere vehicles that deliver instruction but do not influence student achievement any more than the truck that delivers our groceries causes changes in our nutrition." (p. 445). While computer instruction is considered effective (Balajthy, 1987), and many studies already cited support this claim, cautions as expressed must be heeded, and computer-assisted instruction cannot be considered a guarantee for effective remedial programming. Basic to the success of its inclusion in the curricula must be a grounding in proven research and its careful management by professional and informed educators who are aware of the benefits and limitations of computer-assisted instruction.

Such concerns call for continued research. This research should include the development or evaluation of appropriate research-based software, and be coupled with more inservice training for teachers in how to adapt the software to their students needs. Hopefully the situation in which teachers choose software simply because it is available (Steier, 1987) will become less commonplace, and that computer technology will be used not because it is available, but because it is most appropriate for the specific needs of the students concerned.

The findings of the present study are presented in response to these concerns. They are presented cautiously, as suggestive and in need of additional research as indicated. The two computer-assisted programs are considered suitable for struggling adolescent readers, with modifications and cautions as noted. It is hoped that this study, however limited, may contribute to appropriate remedial programming for the secondary school's unskilled readers, with a view to improving the literacy skills of the next generation of adults.

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Appendix 1

AUTOSKILL SUBTYPES DETERMINATION

STUDENT: ______________________________

DATE : ______________________________

SCHOOL: ______________________________

ORAL READING:

1. Auditory-Visual Match and Visual Match relatively good compared to Oral Reading
2. Oral Reading & Visual Scan relatively poor
3. Visual Scan poor, but not as poor as Oral Reading

ASSOCIATIVE:

1. Visual Scan relatively good, and better than Visual Match
2. Audio-Visual Match relatively poor
3. Visual Match poor, but not as poor as Auditory-Visual Match
4. Auditory-Visual Match for letters very poor

SEQUENTIAL (TYPE S)

1. All single letter tests good, compared to letter combinations
2. Visual Scan poor only on NARP & spot
3. Relatively poor performance on Visual Match for words & syllables

Classification : Oral Reading
Associative
Sequential

[Based upon guidelines provided by Fiedorowicz and Trites (1985)]

Appendix 2

Subtescs in the Autoskill Component Reading Subskills Training Program.

Oral Reading Procedure	Auditory-Visual Matching Procedure	Visual Matching Procedure
*letter names	letter names	letter names
letter sounds	letter sounds	
**cv-vc syllables	cv-vc syllables	cv-vc syllables
cvc syllables	cvc syllables	cvc syllables
cvc words	cvc words	cvc words
cvvc syllables	cvvc syllables	cvvc syllables
cvvc words	cvvc words	cvvc words
cvcv syllables	cvcv syllables	cvcv syllables
cvcv words	cvcv words	cvcv words
ccvc syllables	ccvc syllables	ccvc syllables
ccvc words	ccvc words	ccvc syllables
cvcc syllables	cvcc syllables	cvcc syllables
cvcc words	cvcc words	cvcc words
words Grade 1-8	words Grade 1-8	words Grade 1-8
phrases Grade 1-8		
sentences Grade 1-8		

Conditions: Simultaneous presentation of sample item and choices,
50 trials per subtest
10 sec. latency limit per trial
0 sec. intertrial interval
300 msec. correct response signal
1500 msec. incorrect response signal

* both upper- and lower-case letters
** c = consonant, v = vowel

(From Fiedorowicz & Trites, 1987 - Table 7.7, page 127)

Appendix 3

AUTOSKILL NONSENSE SYLLABLES: Pronunciation Guide

1. CV/VC: The vowel <u>must</u> sound SHORT as in ...

<u>A</u>T <u>E</u>GG <u>I</u>T <u>O</u>N <u>U</u>S

EXAMPLES:				
	ug	og	ub	va
	ed	vu	ve	al
	ze	mo	ki	ru
	ki	ot	ke	ez
	ru	im	un	du
	ve	ev	ot	ni
	ba	os	ep	ta
	ed	mi	uf	yi
	ib	ac	zi	gu
	gu	el	et	vo
	pe	ip	ac	mi
	ne	ag	tu	ja

---

2. CVC....The vowel <u>must</u> sound SHORT, as in ...

<u>A</u>T <u>E</u>GG <u>I</u>T <u>O</u>N <u>U</u>S

EXAMPLES:				
	dib	keb	jix	det
	jix	pab	lig	hib
	buv	cag	foz	nel
	saf	yop	det	kig
	siv	kig	mem	pes
	nug	daf	kip	fax
	wap	duj	foz	lev
	bep	dob	tav	bap

3. CVVC...USUALLY, the first vowel is LONG. But, the following must be pronounced as in the examples...

LONG: RAIN BEAT BOAT OTHER: SOON OUT POINT FAULT

EXAMPLES:	noul	noam	toop
	toop	reas	peab
	waut	foif	gaid
	voiz	feam	laif
	couk	bord	teep
	soib	daik	loag
	baip	haip	jaik
	yauk	youp	foud
	taum	boid	haim
	coog	joud	toig
	seeg	foif	loof
	keek	poit	caup

- -

4. CVCV...the first vowel must be pronounced LONG as in ...

ATE EVE MINE POKE USE

EXAMPLES:	tave	jike	gope
	pabe	fibe	zipe
	haje	feve	taje
	fafe	dibe	sebe
	doke	vobe	coje
	fafe	bibe	zete
	toje	teve	vime
	zoke	mafe	vime
	yame	kebe	hibe

5.CCVC...the vowel <u>must</u> be pronounced SHORT as in ...

<u>A</u>T <u>E</u>GG <u>I</u>T <u>O</u>N <u>U</u>S

EXAMPLES:			
	brip	cref	drem
	cruf	criz	cluf
	blen	bren	blun
	crob	drob	dref
	crup	blog	dros
	grem	clon	clib
	craj	dleb	slad
	creb	cron	blin
	cret	brit	druz
	drim	clat	bram

---

6. CVCC...the vowel is <u>usually</u> short. <u>BUT</u>, the following sounds may <u>also</u> be accepted.

C<u>OLD</u> CH<u>ILD</u> C<u>OLT</u> H<u>ALT</u>

EXAMPLES:			
	dolt	milt	guld
	galt	keld	pamp
	nilt	nump	lomp
	ruct	sict	kuld
	beld	moct	ruld
	nolt	hald	mict
	hald	pemp	cump
	celd	dold	bact
	pold	galt	bict
	komp	kimp	lemp
	kelt	gimp	jamp

7. Be careful of C and G...

e, and i after the c or g, give it a soft sound.

SOFT		HARD	
EXAMPLE: cent	gem	EXAMPLE: can	gave
Cindy	gin	cone	go
		cut	gull
celt	gesp		
cig	giv	caup	galt
		bict	hig
		clog	feeg

8. Remember that S can be pronounced as s or z:

EXAMPLE: is.....(sounds like z)
sell...(sounds like s)
bus....(sounds like s)

Appendix 4

A TUTORING CHECKLIST

A: Use the table below to reflect on your participation in the tutoring project. Be as honest with yourself as possible. This exercise is not intended to be an evaluation of your performance. Rather, this information will be used to assist in preparing other students to be tutors in the future.

	YES!	NO	SOMETIMES
1. I greeted the tutee cheerfully at the beginning of the session			
2. I began by talking to the tutee about something he/she was interested in.			
3. I looked directly at the tutee when either of us was speaking.			
4. I spoke slowly and clearly.			
5. I tried to encourage the tutee when he/she was having difficulty.			
6. I praised the tutee when he/she showed improvement.			
7. I tried to teach the tutee those skills he/she found difficult.			
8. I was pleasant, even when the tutee was having difficulty or not enjoying the work.			
9. I tried to set a good example by paying attention through the session.			
10. I shared any unsolved problems with the teacher.			

B: Difficulties

1. What was most difficult in your role as tutor?

____

____

C: Advice To Future Tutors

Imagine that you are to teach Grade 11 students "how to be tutors". List 3 skills you think tutors should learn, before beginning the tutoring experience.

1. ____

2. ____

3. ____

D: Feedback On Computer Programs

1. Which computer program(s) did you work with? If you worked with both, check the one you worked with the most.

1. Autoskill ______
2. Read It Again, Sam______

2. What were the strengths of the program? (What was good about it?)

____

____

____

3. What were the weaknesses of the program? (What should be improved?)

____

____

____

Appendix 5

Read It Again, Sam: Sample Stories

Grade 2

Woodpeckers get hungry. And when they do, they turn into bug-hunters. Clem the woodpecker was one of the best. Hunger pangs got him up quick as a flash. It was time to hunt again.

Clem spotted a stump with an empty nest on it. On a hunch, he fluttered across to it. Tap-tap-tap-tap. His bill began to peck like a hammer..

Clem's hunch was right - lots of bugs to stuff himself with. When he had filled himself with them, Clem hopped to the empty nest. He sat in it.. He was thinking of the big fat insects that he had gobbled up.

Then he began to flutter his wings. He felt a tug on his leg. His leg was held fast by a string twisted into the nest. What bad luck!

Clem flapped his wings and tugged at the string. But it still held him fast. Suddenly Clem fell from the nest. Down he went! The string was still twisted on his leg and he was dangling from the end of it. What a fix!

But luck was with Clem. A boy came jogging past. Tenderly, the boy cut the string off. Now Clem was free to hunt again!

Read It Again, Sam: Sample Stories

Grade 3

A boy is pleased and thrilled when he receives his first bicycle. He will be able to ride off on all kinds of trips. He will be able to go places which were too far away for him to walk. The story of the bicycle is more than a hundred years old. The first bicycle was quite unlike the ones we have now. It had no pedals, no brakes, no rubber tires.

It was called a hobby horse. It was just a pair of wheels placed one in front of the other joined by a bar on which a seat was fixed. There were handle-bars to hold. The rider sat on the seat and pushed himself with his feet. It must have been hard work going uphill. Going downhill was risky because there were no brakes. Many a brave young man fell off into a ditch.

It was not long before changes were made. Springs were used to stop the rider being jarred on rough roads. Then came the pedals. They worked directly on the wheel and kept moving when the bicycle was going downhill. These bicycles were called bone-shakers. They were made for the young and strong.

Read It Again, Sam: Sample Stories

Grade 4

As he neared the tunnel under the prison, Peter shone the flashlight ahead and called softly to John. He was afraid to call loudly, for he was now under the wire and close to the sentry's beat. He passed the bend where they had changed course, and came to the end of the tunnel.

He thought he would find John. There was nothing but a solid wall of sand.

John must have been digging steadily on and in banking up the sand behind him had completely blocked the tunnel.

Peter bored a small hole through the wall of sand.

As he broke through, a gust of hot, stale air gushed out and there was John, wringing wet with perspiration. Sand clung to his face where he had sweated and his hair, caked with sand, fell forward over this eyes. He looked pale and tired under the yellow light of Peter's flashlight.

"Where on earth have you been?" he asked.

"It's only just about four-thirty," Peter said.

"I though it must be past six. I seem to have been down here for hours. I was afraid you'd been captured and I'd have to go out alone."

Read It Again, Sam: Sample Stories

Grade 5

For several days they struggled up the stream in canoes. The mountains reared up behind them now, as well as ahead. On all sides were high, snow-covered peaks. They were passing through the heart of the Rockies.

Every day, every hour, they looked for an opening that would lead them to a wide river flowing to the west. But no sign of such a place could be found.

As the going grew harder and harder, the men became less sure that they would reach the Pacific Ocean. The leader, Mackenzie himself began to lose hope.

Unless they met some natives who could lead them to a route, there was only one thing to do. They must push ahead on this stream until they could go no farther.

Mackenzie was sitting in the canoe thinking about this. His dog began to bark loudly. His men smelled smoke from a campfire. A little later, they heard someone in the woods.

That Indians might be following them along the shore frightened Mackenzie and his men. Were they hostile Indians, or were they friendly?

Mackenzie suddenly remembered his guns were not ready to be fired. If the Indians should attack, he would be in serious trouble.

Read It Again, Sam: Sample Stories

Grade 6

In May 1951 I had tried to slip across the border to see my parents. I was stopped at the frontier and turned back, with my passport marked "Illegal Crossing of the Border." Now, trying again in September, I had got through. But to be caught a second time would mean something far worse than a stamp on my passport.

I felt I had a good chance to get back into free Germany, because of the map my brother had drawn for me. It gave the exact locations of the border guards and the times some posts were not guarded.

My watch showed eleven o'clock. For two hours I walked a lonely country road. When a village came into view I turned right into the forest that stretched across the frontier. I struck a match for a last look at my map and walked on. Every few minutes I stood still, listening to be sure the rustling sounds I heard were only wind and leaves. Soon I was close to the path dividing East from West. And then –

"Stop," a voice shouted in Russian. "Stop!" I threw myself on the ground. Two Russian soldiers yanked me to my feet.

Appendix 6

AUTOSKILL TESTING GUIDELINES : ORAL READING PROGRAM

1. Press SPACE BAR to halt TIMING.

2. To indicate accuracy of response: PRESS 0 to indicate 0 errors
   PRESS 1 to indicate an error

3. If student "SOUNDS OUT" the word, say "Say it altogether". Student must say it normally before you may HALT TIMING by pressing spacebar. (If word was sounded out incorrectly, halt timing immediately, and indicate the error by pressing 1)

4. Accept rapid, spontaneous self-corrections.

5. This program demands the short vowel sound for VOWELS presented alone, or following a consonant (CV). If the student gives the long vowel sound, PRESS TIMER and then SAY, "This vowel also makes ANOTHER SOUND. Can you say it with the other sound?" Indicate a correct answer if student responds appropriately. If after TWO PROMPTS, the student persists with the long sound, cease prompting.

6. GUIDELINES for NONSENSE SYLLABLES

CV	The SHORT vowel sound is required.
VC	HOWEVER, in addition, accept old...as in sold
CVC	ild...as in mild
CCVC	olt...as in colt
CVCC	alt...as in salt
CVCV	The LONG vowel sound is required.
CVVC	Accept ou...as in out ea...as in beat oa...as in boot ai...as in paid HOWEVER, in addition, accept any reasonable pronunciation.
CVCC	g and c are usually soft followed by e (gem) i (gin) g and c are usually hard followed by a (gander) o (got) u (gun)

HOWEVER, accept reasonable alternatives.

Appendix 7

READ IT AGAIN, SAM : GETTING STARTED

1. Login: rias

2. Password: adelethomas

3. When you see type <cr>, press ENTER

4. When you see the menu, press F5. New student to test

5. When you see Would you like to see a list of student names?, press N, ENTER

6. When you see Please enter the name of the student to locate, type in the student's first and last name.

7. When you see Success...requested student found, press ENTER

8. Press F1 Read the next story

GUIDELINES FOR TUTORS

Put the student at ease. The purpose of this computer activity is like "batting practice" - the more you do it the faster you become. There is no pressure "to get it right". The student works at his own pace but aims to get faster.

As tutor, your job is to get him/her started, to help record progress, and to keep interest and motivation high.

PROCEDURES FOR EACH NEW PASSAGE

Step 1 PRESS THE SPACEBAR to start the timing.
Student reads the passage orally to the tutor.
Tutor records the errors by pressing the #1 key.
Score as many errors as the student makes while reading to you. (Sit near the keyboard and keep your hand on the number key so the student's attention is not drawn to your activity.)
DO NOT give the answers or corrections at this time. Let him/her read the passage right through.

ERRORS INCLUDE:

1. mispronunciation (jucus for juicy)
2. substitution (hat for cap)
3. addition (inserting a word not there)
4. deletion (student skips over a word)

PRESS THE SPACEBAR to stop the clock, as soon as he/she stops reading.

Step 2 Ask the questions about the story. Record the student's answers. BE SURE you have filled in the information at the top of the page, and have circled the passage number. Tell the student you will now read the passage together. He can read along silently, but you will prefer that he read aloud with you. You will read aloud in a normal manner with good expression. Be sure to ask if he has any questions before you leave him/her to practice on his/her own.

Step 4 The student practices independently until he/she reaches a target of 100 wpm. The number of readings depends on the student. Each student records his time by pressing the spacebar to start and end his timing.

Step 5 When the student reaches 100 wpm he/she tells the tutor. The tutor hears the student read orally for the last time. Tutor records the accuracy (by using number keys) and speed (by pressing spacebar before and after)

*** STUDENT GOES ON TO THE NEXT PASSAGE (IN ORDER), AND BEGINS AGAIN WITH STEP 1. ***

Appendix 8

READ IT AGAIN SAM - STUDENT FORM

STUDENT ______________________________

DATE: ______________ TUTOR ______________

SET F	51	52	53	54	55	56	57	58	59	60
SET G	61	62	63	64	65	66	67	68	69	70
SET H	71	72	73	74	75	76	77	78	79	80
SET I	81	82	83	84	85	86	87	88	89	90
SET J	91	92	93	94	95	96	97	98	99	100

WHAT WAS THE STORY MAINLY ABOUT? GIVE A SUMMARY IN TWO SENTENCES. USE YOUR OWN WORDS.

1. ______________________________

____

2. ______________________________

____

MAKE UP A GOOD TITLE FOR THIS STORY:

____

RECALL TWO THINGS ABOUT THE STORY, SUCH AS THE NAME OF THE MAIN CHARACTER, THE PLACE, OR SOMETHING THAT HAPPENED.

1. ______________________________

____

2. ______________________________

____

DID YOU ...fill in the information at the top of this sheet?
circle the appropriate number?

*** Please return this sheet at the end of the session ***

Appendix 9

SPEED AND ACCURACY RECORD: PLAY IT AGAIN, SAM

STUDENT ______________________________

PASSAGE NUMBER ________________________

Reading Number	1 TUTOR	2	3	4	5 TUTOR
250					
240					
230					
220					
210					
200					
190					
180					
170					
160					
150					
140					
130					
120					
110					
100					
90					
80					
Number of Errors					

Mark the number of minutes needed to read the story with an "x".

Write the WPM (words per minute) in the column.

Write the number of errors at the bottom.

Appendix 10

DAILY AUTOSKILL PROGRESS RECORD

NAME OF STUDENT: ______________________________

NAME OF TUTOR: ______________________________

- -

DATE: ______________________
(Month) (Date) (Year)

TITLE: Oral Reading Auditory/Visual Visual Match
(Circle only one)

SUBTEST NAME ____________________

PRACTICE BLOCK NUMBER 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17

18 19 20 21 22 23 24 25 26 27 28 29 30

*** At the end of each block, discuss the graphs with your student. Then examine the <u>Detail</u>. When your student first achieves <u>4 % trials error, or less</u>, begin to record below. If in <u>three consecutive tries</u>, your student achieves...

a) 4 % or less, <u>and</u> ...
b) median latency within 100 milliseconds...

***BEGIN YOUR STUDENT ON THE <u>NEXT SUBTEST</u>. Begin a new Progress Record page at the same time.

- -

PRACTICE NUMBER ____ PRACTICE NUMBER ___

Trials % errors _______% Trials % errors _______%

Latency med. _______ Latency med. _______

- -

PRACTICE NUMBER ____ PRACTICE NUMBER ____

Trials % errors _______% Trials % errors ______%

Latency med. _______ Latency med. _______

- -

PRACTICE NUMBER ____ PRACTICE NUMBER ____

Trials % errors _______% Trials % errors _______

Latency med. _______ Latency med. _______

Appendix 11

Means and standard deviations of the raw scores for the Autoskill test procedures for Types O, A, and S and the Untrained Control group at pretest and posttest.

Autoskill Test Procedures		Type O M (SD)	Type A M (SD)	Type S M (SD)	Untrained Control M (SD)
Oral Reading					
Errors	Pre	35.5 (11.7)	34.6 (14.2)	39.1 (17.8)	38.0 (20.7)
	Post	13.5 (9.0)	21.3 (17.4)	26.7 (18.3)	32.6 (19.8)
Latency	Pre	1691.2(492.3)	1858.7(750.7)	1986.3(1079.3)	1745.3(387.2)
	Post	1163.8(334.2)	1517.3(715.2)	1637.6 (969.2)	1460.7(264.3)
Auditory-Visual Matching					
Errors	Pre	22.7 (7.0)	26.5 (9.3)	25.6 (10.9)	27.1 (11.2)
	Post	16.5 (6.6)	10.0 (5.3)	22.9 (10.5)	21.6 (9.8)
Latency	Pre	1877.2(312.1)	2001.1(523.9)	2347.5 (866.6)	1978.4(563.7)
	Post	1516.9(389.4)	1416.2(561.9)	1483.5 (433.6)	1729.7(480.3)
Visual Matching					
Errors	Pre	4.5 (3.1)	8.5 (8.0)	9.0 (5.6)	9.4 (11.5)
	Post	6.1 (3.7)	5.7 (4.3)	7.9 (5.2)	7.3 (6.6)
Latency	Pre	1819.0(453.8)	1884.1(459.3)	2410.5 (917.6)	1976.5(936.6)
	Post	1399.5(397.3)	1439.5(586.8)	1251.0 (311.1)	1643.5(323.5)

(From Fiedorowicz & Trites - Table 8.6, page 151)